VOLUME 58 NUMBER 6

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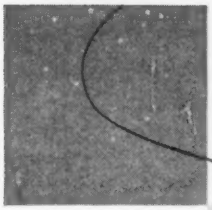

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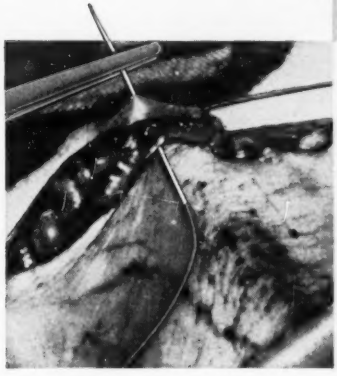

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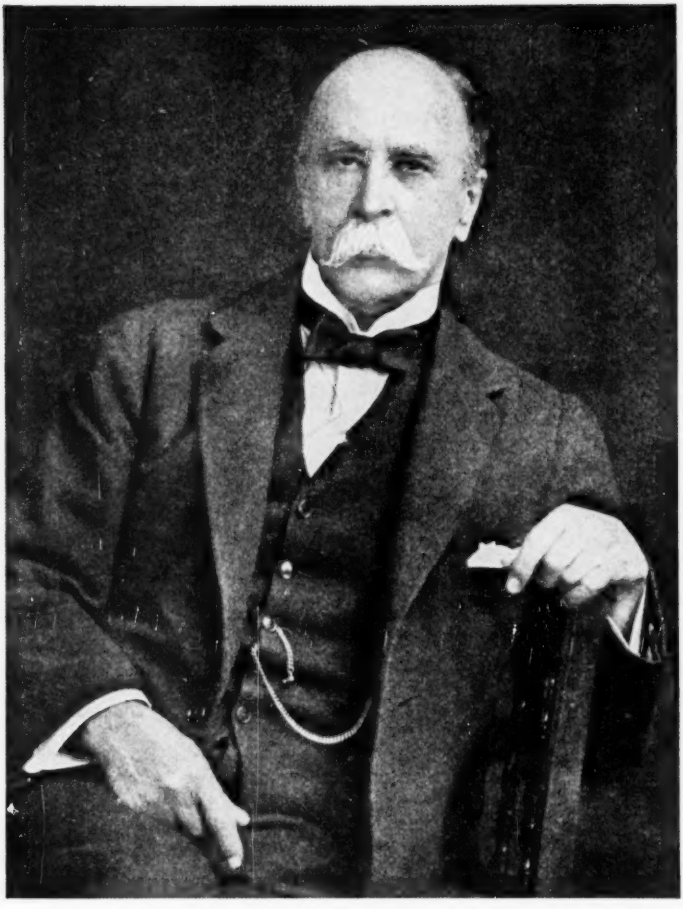

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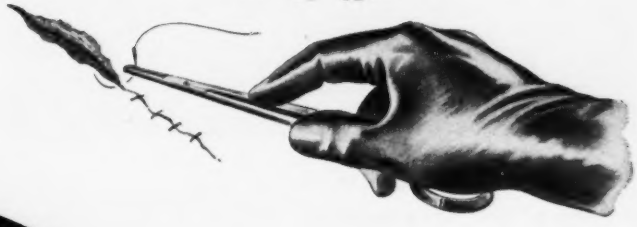

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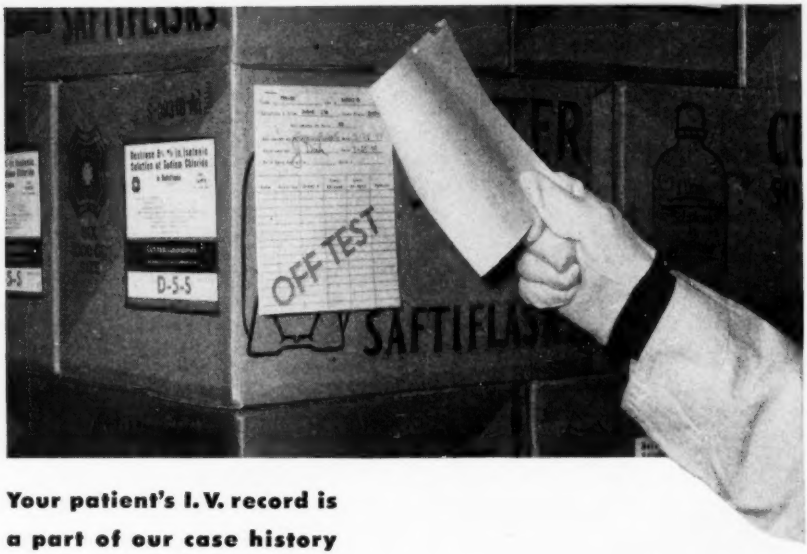


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# PREFRONTAL LOBOTOMY IN THE MANAGEMENT OF INTRACTABLE PAIN

COLONEL FRANK E. HAMILTON
AND
MAJOR GEORGE J. HAYES,
MEDICAL CORPS, UNITED STATES ARMY

ON OCCASION pain is a useful thing. It may aid in achieving a diagnosis or it may merely bring a patient to a physician so that his ill may be diagnosed. Our purpose is not to talk about such pain but rather to discuss a treatment for pain which results from carcinoma, causalgia or some other condition in which the pain is serving no useful purpose. There are various methods of treating such pain; opiates, sedatives, alcohol injection, neurectomy, rhizotomy and cordotomy all have their place, but in certain cases none of these may achieve the desired result. Prefrontal lobotomy, originally used for psychosis, has been proposed [1] and used by a number of persons faced with this problem. Freeman and Watts [2] first used prefrontal lobotomy for pain associated with involutional depression in 1936 and have since then performed it on approximately 25 patients having pain of solely organic nature. Mason and Hamby [3] described a case of paraplegia associated with morphine addiction in which prefrontal lobotomy relieved the pain as well as the addiction, with no evidence of symptoms of morphine withdrawal. Similar encouraging experiences have been had by others [4] using this method (fig. 1). The close association with Dr. Watts, a consultant to the Neurosurgical Section at Walter Reed General Hospital, and the previous experience of one

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 2, 1948.

1. White, J. C.: Pain After Amputation and Its Treatment, J. A. M. A. **124**:1030 (April 8) 1944. Walker, A. E.: Central Representation of Pain, A. Research Nerv. & Ment. Dis., Proc. **23**:63, 1943.

2. Freeman, W., and Watts, J. W.: Pain of Organic Disease Relieved by Prefrontal Lobotomy, Lancet **1**:953, 1946.

3. Mason, T. H., and Hamby, W. B.: Relief of Morphine Addiction by Prefrontal Lobotomy, J. A. M. A. **136**:1039 (April 17) 1948.

4. Van Wagenen, W. P.: Unpublished data, cited by Walker, A. E.: Central Representation of Pain, A. Research Nerv. & Ment. Dis., Proc. **23**:63, 1943. Poppen, J. L.: Prefrontal Lobotomy for Intractable Pain: Case Report, Lahey Clin. Bull. **4**:205, 1946. Horrax, G.: Experiences with Cortical Excisions for the Relief of Intractable Pain in the Extremities, Surgery **21**:593, 1946.

of us under the guidance of Dr. Poppen stimulated interest in using prefrontal lobotomy for pain of organic nature not amenable to other modes of therapy. There are three generally accepted methods of performing prefrontal lobotomy in use commonly today. Unilateral lobotomy has been done; as yet we have had no experience with it.

The first method is the classic procedure of Freeman and Watts. The orientation point is the pterion; a perforation is made approximately 2 cm. or less in diameter. A leukotome is introduced, and by means of a vertical sweeping cut and then by radial stabs the frontothalamic pathways are severed. The plane of incision is roughly shown (fig. 2). The path of the blade may be visualized by means of iodized poppyseed oil placed in the tract of section (fig. 3). The plane of section lies posterior to the crista Sylvia and makes an obtuse angle with the floor of the frontal fossa.

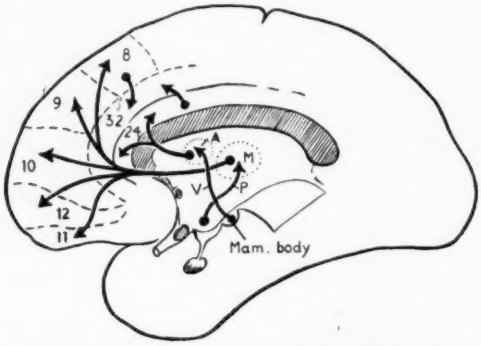


Fig. 1.—Frontal thalamic pathways, the section of which is of apparent importance for the relief of intractable pain. (Le Gross Clark, W. E.: The Connexion of the Frontal Lobes of the Brain, Lancet **1**:6497, 1948.)

Recently Freeman [5] has introduced the procedure of transorbital lobotomy. This was first described by Fiamberti, of Italy, who injected alcohol or solution of formaldehyde into the frontal lobes. A stainless steel stylus is introduced across the orbit, punctures the roof of the orbit, enters the inferior aspect of the frontal lobes and is swept transversely to sever the fiber tracts (fig. 4).

The Lyerly technic with modification was used most commonly in our cases. Two and one-half centimeter buttons are removed 4 to 5 cm. lateral to the midline from the frontal bone anterior to the coronal suture. Originally the Lyerly technic based these trephine openings at the coronal suture. We have found, in accord with the observation

5. Freeman, W.: Personal communication to the authors.

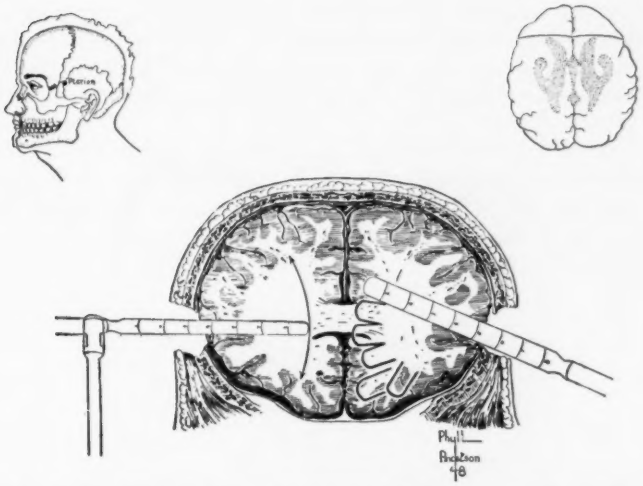

Fig. 2.—The classic method of Freeman and Watts for severing the myelinated tissue of the frontal pole.

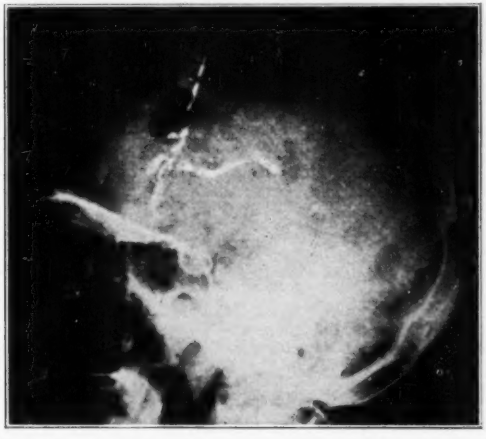

Fig. 3.—Iodized poppyseed oil in the plane of section following lobotomy by the technic of Freeman and Watts.

of Otenasek [6] that we can with advantage move the plane of section somewhat forward. A core of cortical and myelinated tissue is removed by suction and cautery, then lateral cuts and stabs are made with a spatula cutting the fiber pathways (fig. 5).

The resultant plane of section is possibly somewhat anterior to the crista Sylvia and is almost perpendicular to the plane of the frontal

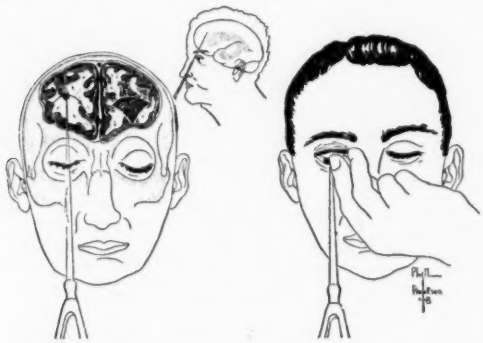

Fig. 4.—Transorbital lobotomy with the indicated plane of section and amount of tissue severed.

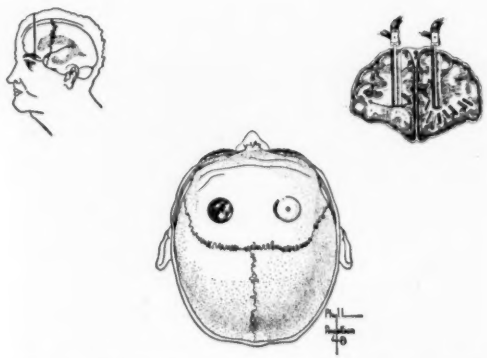

Fig. 5.—Lyerly technic for lobotomy modified by moving the plane of section forward and making it more perpendicular to the plane of the orbital cortex.

fossa (fig. 6). All operations are performed under local anesthesia. During the procedure a battery of questions is asked by an assistant to evaluate the responses for factual accuracy as well as for changes

6. Otenasek, F. J.: Prefrontal Lobotomy for the Relief of Intractable Pain, Bull. Johns Hopkins Hosp. **83**:229, 1948.

in voice modulation, which is a reflection of emotional overtone. The section of fiber pathways is stopped when one of two factors supervenes, i.e., either slight disorientation or an appreciable flattening in the voice tone. Usually when either of these occurs the patient ceases spontaneously to complain of pain.

We have had in all 16 patients (table 1). There have been 3 deaths (18 per cent) directly associated with surgical treatment, 1 due to hemorrhage five days postoperatively, 1 following convulsion occurring at operation, the reason for which has never been clearly ascertained, and the last from a self-inflicted infection of the lobotomy incision with brain abscess and meningitis. The reactions following surgical intervention for previously disabling pain as observed in this series range

Fig. 6.—Tantalum wires placed in the plane of section showing modified Lyerly technic.

TABLE 1.—*Cause of Pain*

| | |
|---|---|
| Carcinoma | 10 |
| Painful fantom limb | 3 |
| Causalgia | 1 |
| Quadriplegic spasm | 1 |
| Tabetic crisis | 1 |

from complete denial of pain to no admission of benefit. The intermediate levels are (*a*) affirmative statements of pain on direct questioning but absence of any spontaneous complaint referable to it, (*b*) occasional complaints of pain made spontaneously but with no apparent real distress requiring medication and (*c*) a lowering of the preoperative

general distress, with a lessened but continued need for medication. These have been graded 4 plus for denial of pain to zero for no benefit (table 2).

An important item for consideration is the social status of the patient. This embraces his reaction to the persons around him in or out of a hospital environment. The desirable goal is a person who is essentially unchanged. This cannot always be achieved, especially in the immediate postoperative phase. However, with the passage of time the social adjustment of the disoriented patient improves usually to a level at which adequate adjustment in a home or hospital environment is possible (table 3).

TABLE 2.—*Relief of Pain**

| 4 Plus | 3 Plus | 2 Plus | 1 Plus | 0 |
|---|---|---|---|---|
| 5 | 7 | 1 | 1 | 1 |

* In this computation 1 postoperative death is not included.

TABLE 3.—*Social Adjustment After Lobotomy*

| Social Recovery * | |
|---|---|
| Excellent | Good |
| 6 | 7 |
| **Time Required** | |
| Excellent | Good |
| Minimum, 1 day | Minimum, 2 wk. |
| Maximum, 2 mo. | Maximum, 3 mo. |

* Three postoperative deaths are not included.

## COMMENT

The exact mechanism for the relief obtained after lobotomy is not certain. It has been postulated that dissociation occurs, separating the emotional reaction to pain from the more physiologic stimulus of pain. This may be exemplified by patients who still experience pain yet show no distress because of it. However, there are patients who after lobotomy constantly deny the existence of pain of the type which was present prior to operation. All these patients react to acute pain such as pinprick and removal of sutures in a normal or even hyperactive manner. The question of the plane of section in relation to the tip of the frontal horns is one which has been of pertinent interest to us, inasmuch as the farther forward from the frontal horns one is able to establish the plane of section, the less severe is the disorientation and the less prolonged the social rehabilitation of the patient. We have been successful with a plane of section anterior, by at least 1 cm., to the tips of the frontal horns.

The face of each frontal pole as seen after coronal section may be divided into four quadrants—the upper medial and lateral and the lower medial and lateral. There is some question of the necessity of dividing the fiber tracts from all four quadrants of each frontal pole. Approximately half of our patients have had satisfactory result from section of only both lower quadrants bilaterally or from section of both lower quadrants bilaterally with section of only the medial quadrants superiorly. This indication that the lower quadrants are more closely associated with the relief of pain than the upper quadrants is in accord with observations of Watts [7] and Koskoff.[8] It is not possible to say definitely that section of only lower quadrants will achieve the desired result, but at least it does seem that it is necessary to sever the pathways in the lower quadrants for relief of pain.

Relationship of the amount of relief from pain to social acceptability does not seem to be constant. There are patients who deny pain which was previously present but who show social aberration after lobotomy.

TABLE 4.—*Symptoms of Morphine Withdrawal*

| | Patients |
|---|---|
| Total patients | 16 |
| Morphine users | 13 |
| Showed withdrawal signs | 9 |
| Showed no withdrawal signs | 3 |
| Died two days postoperatively | 1 |

There are other patients who still complain of pain, even with some sign of emotional distress related to it, who have rather notable disorientation. At this time it is impossible to make a close correlation between these two factors. It has been our impression, however, that by moving the plane of section forward and by making it as nearly as possible perpendicular to the frontal fossa, social disorientation is reduced while relief from pain is maintained at a satisfactory level. This is in agreement with the findings of Otenasek.[6]

The effect on morphine addiction as far as physiologic manifestations are concerned in our series is at variance with the findings of Mason and Hamby.[3] The majority of our patients who had been forced to use large amounts of morphine for prolonged periods (often as much as ¼ to ½ grain [15 to 30 mg.] every one and a half to two hours) showed tremor, sweating and diarrhea in the first days after operation. Some were given no morphine, and it was observed that these signs

7. Watts, J. W.: Personal communication to the author.

8. Koskoff, Y. D.; Dennis, W.; Lazovik, D., and Wheeler, E. T.: The Psychological Effects of Frontal Lobotomy Performed for the Alleviation of Pain, A. Research Nerv. & Ment. Dis., Proc. **27**:723, 1948.

gradually disappeared over a period of four to five days. Others were given morphine after the signs had become established, with immediate cessation of the signs of morphine withdrawal, no recurrence and a gradually diminishing physiologic need for morphine. None of the patients who showed withdrawal signs complained of discomfort related to those signs, nor did they ask for morphine to alleviate them. Apparently the older concept of psychic and physiologic addiction to morphine still holds true.

We wish to make clear that, while we consider lobotomy a useful procedure in certain circumstances, we do not feel that it should be used indiscriminately for pain as a symptom. Although great care is taken to avoid so much of a section as to render the patient permanently or for a long time incapable of social rehabilitation or so little of a section as not to relieve his pain, because of the variability of the landmarks used in determining the plane of section this is not always possible.

## DISCUSSION

Dr. W. P. Ritchie, St. Paul: My experience has been limited to only 5 cases, 4 with excellent results and 1 with a fair result.

It is evident to me that one must temper one's enthusiasm for this procedure by a most careful evaluation of the type of person, particularly if he is nonpsychotic. This was rather forcefully brought to my attention when the opportunity presented itself to perform a prefrontal lobotomy for pain on a close relative of mine who had metastatic carcinoma of the spine. This man had always been a valued member of his community. His intellectual ability was high, and he was greatly respected. In spite of my enthusiasm for this procedure there was no question in my mind, and also no question in the family's mind when it was explained to them, that it would be wrong to take any chance of impairing this man's intellect and his value to his community. If he had nothing to offer to his community it certainly would have been done; he still is an active man in spite of his pain.

Bilateral prefrontal lobotomy is not without its unmixed blessings, and I think everyone who performs this procedure feels that it never should be performed unless life has become unbearable and all other methods for the relief of the trouble have been exhausted.

Major George J. Hayes, Washington, D. C.: Dr. Ritchie has put his finger on the important point in the use of lobotomy for the treatment of pain. We do not feel (and I emphasize what I said before) that it should be used indiscriminately. It has so many variables that one cannot accurately predict what the result will be.

The only thing we can say is that, from the more recent cases of our series, with the change in the plane of section establishing it a little forward of the frontal horns and making it more perpendicular to the floor of the frontal fossa, the social disorientation lasts for a much shorter time and may not even be present. Our last patient was never disoriented and completely denied pain. In no circumstances would I say that we can guarantee what the result is going to be in any given operation. Our feeling is that this is a procedure which is worthy of development to determine of how much value it is going to be to the general practitioner who is faced with the problem of pain.

# SURGICAL MANAGEMENT OF INSTRUMENTAL PERFORATION OF THE ESOPHAGUS

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OMAHA

PERFORATION of the esophagus from instrumentation is a tragic accident and an urgent surgical emergency. Unless promptly and properly treated, it is usually fatal. Proper treatment consists of the immediate establishment of wide and free drainage to the site of perforation in addition to adequate antibiotic and supportive therapy and other less important measures. This has been emphasized by Hoover,[1] Touroff [2] and others.

Although this discussion is concerned with perforation caused by instrumentation, it would seem desirable to include a classification of all causes.

A. Intrinsic causes
   1. Tumors arising in the oesophagus
   2. Esophagitis
      Nonspecific, tuberculous, syphilitic
   3. Spontaneous perforations
      Ruptures from violent vomiting
   4. Ulceration
      Peptic, Curling's (Rankin)[3]

B. Extrinsic causes
   1. Instrumentation
      Endoscopy, dilation
   2. Swallowed foreign bodies
      Bones, dentures, pins
   3. Penetrating wounds
      Stab, bullet
   4. Penetration of extrinsic neoplasms

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Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 2, 1948.

1. Hoover, W. B.: Mediastinitis as a Complication of Esophagoscopy and Instrumentation of the Esophagus, S. Clin. North America **25**:575-578, 1944.

2. Touroff, A. S. W., and others: Perforation of the Cervical Esophagus with the Flexible Gastroscope: Case Report, Ann. Surg. **114**:369-374, 1941.

3. Rankin, L. M.: Perforated Ulcer of the Esophagus Following a Burn, Am. J. Surg. **67**:134-136, 1945.

5. Perforations of extrinsic infections
   Pyogenic and tuberculous adenitis and mediastinal abscesses
6. Aortic aneurysm
7. Ulceration due to swallowed caustics and indwelling gastric tubes (Hayes) [4]

From a clinical point of view these etiologic factors may be grouped under the following headings.

1. Slowly perforating lesions, erosion of tumors and some foreign bodies
2. Minute perforations, as those by pins and fish bones
3. Gross immediate perforations, from instrumentation, penetrating wounds and spontaneous rupture during vomiting

In the first two groups there is an opportunity for walling off the involved area before perforation takes place so that soiling and infection remain localized or spread slowly in the majority of cases. It is in this group that cures have followed either conservative management or late drainage of localized abscesses, and, unfortunately, the reported successes in these cases have been misinterpreted as evidence in support of conservative management of all types of perforation.

In the third group gross soiling takes place immediately and within a few hours infection may extend throughout the involved spaces, in perforations of the proximal portion of the esophagus throughout the entire retrovisceral space and superior mediastinum, an area extending from the occiput to the bifurcation of the trachea, and in perforations of the distal half of the organ the posterior mediastinum and not infrequently one or both pleural cavities. This rapid and extensive spread of infection is favored by several factors. First, the retrovisceral space and the mediastinum contain no tissue barriers except loose areolar tissue and the retrovisceral space communicates with the superior mediastinum with no more than an area of narrowing at the thoracic inlet to impede the spread. The indirect communication between the superior and posterior mediastinums at the root of the lungs appears to be a more effective barrier. Immediately after perforation swallowed air is forced through the rent and quickly inflates the spaces so that they are open to the more or less free passage of bacteria-laden saliva. The esophagus always harbors a rich flora of pathogens. Furthermore, it would seem plausible that during the negative phases of intrathoracic pressure in inspiration the contents of the retrovisceral space and those of the esophagus itself are aspirated into the mediastinum. Also the movement of the esophagus in the act of swallowing and the constant motion of the lungs, heart and great vessels discourage the formation of a limiting plastic membrane and otherwise contribute to the spread of infection.

4. Hayes, J. M.: Esophageal Perforation from a Stomach Tube, Minnesota Med. **25**:280 and 306, 1942.

In most of the reported cases of spontaneous perforation of the esophagus, symptoms of rupture have developed after the vomiting of a large meal and at operation or autopsy considerable gastric contents including food have been found in the mediastinum. For more information about this interesting cause of rupture and of perforations resulting from gunshot wounds and other forms of external violence the reader is referred to the publications of Kinsella and others,[5] Sommer and others,[6] Barrett,[7] Collis and his associates [8] and Eliason and Welty.[9] These two types have in common with instrumental perforations certain characteristic signs and symptoms which if recognized will lead to an early diagnosis. In the case of spontaneous rupture, an antemortem diagnosis has been made in only a few instances and then by surgeons who have learned from a past experience the characteristic syndrome. Sudden perforations from any cause promptly give rise to pain which at first is located in the region of the perforation but spreads early and usually becomes severe. Swallowing and respiratory movements increase the pain. In patients with perforations of the distal end of the esophagus shock and cyanosis soon develop, with rapid, shallow, grunting respiration, and they complain with much anxiety that they are "unable to breathe" or tolerate the pain. Usually within a few hours there is a sharp rise in the pulse rate and temperature and not infrequently a chill. Also within minutes or a few hours air appears in the tissues and disseminates and increases rapidly so that subcutaneous emphysema may be demonstrable in the neck within minutes after perforation of the cervical portion of the esophagus and a few hours after perforation of the distal end. The severity, location and progressive diffusion of pain should give rise to a suspicion of a perforation, and the demonstration of air in the tissues either by palpation or in roentgenograms in the absence of the other obvious causes of interstitial emphysema confirms the diagnosis. As pointed out by McGibbon and Mather,[10] the roentgenologic findings in perforation of the cervical portion of the esophagus are rather typical. Early there is the mottling of small areas of lesser density of air scattered in a shadow of tissue

5. Kinsella, T. J.; Morse, R. W., and Hertzog, A. J.: Spontaneous Rupture of the Esophagus, J. Thoracic Surg. **17**:613-631, 1948.

6. Sommer, G. N. J., and O'Brien, C. E.: War Wounds of the Esophagus, J. Thoracic Surg. **17**:393-400, 1948.

7. Barrett, N. R.: Spontaneous Perforation of the Oesophagus, Thorax **1**:48-70, 1946.

8. Collis, J. L.; Humphreys, D. R., and Bond, W. H.: Spontaneous Rupture of the Esophagus, Lancet **2**:179, 1944.

9. Eliason, E. L., and Welty, R. F.: Spontaneous Rupture of the Esophagus, Surg., Gynec. & Obst. **83**:234-238, 1946.

10. McGibbon, J. E. G., and Mather, J. H.: Perforation of the Oesophagus by Swallowed Foreign Bodies, with Radiological Notes, Lancet **2**:593-597, 1935.

density occupying the retrovisceral space more or less completely. Air is also visible in the planes of the neck extending laterally. The pharynx is compressed and the esophagus displaced forward, with widening of the space between them and the vertebral bodies. Subsequently the locules of air may coalesce and, with the development of fluid, present fluid levels.

Involvement of the mediastinums is indicated by an increase in their widths, as outlined early by the lesser density of air and later by the dense shadow of edema and fluid. In the case of instrumental perforations, the diagnosis is simplified by the knowledge or suspicion of injury as observed by the endoscopist or by the recent history of instrumentation.

Instrumental perforations occur most frequently during esophagoscopy. The esophagus may be torn in the process of passing the esophagoscope (cases 1 and 2), particularly at the levels of narrowing, the so-called cricopharyngeal pinchcock and the cardia or in the process of removing a foreign body (case 3) or of a biopsy. Curiously enough, the instrument responsible for the next largest number of cases, as judged from case reports in the literature [11] of the past ten years, is the gastroscope. This is of particular interest in that gastroscopy is considered a simple and safe diagnostic procedure. Perforations with this instrument have occurred principally at the two levels mentioned previously. Ruptures from dilation of strictures (case 4) and of the cardiac sphincter are third in frequency. Aside from these, there are reported only a few instances of such unusual causes as self-inflicted injuries [12] (case 5) and 1 instance of perforation during the passing of a stomach tube.

The mortality, as in the case of sudden perforation of the bowel, tends to vary inversely with the time that elapses prior to surgical intervention. If the endoscopist sees a gross perforation from a foreign body or has the misfortune to tear the wall with his instrument, he should not await confirmatory evidence in the way of signs and symptoms with the exception of a roentgenogram taken immediately. Similarly, if a surgeon suspects that a perforation or a rupture has occurred during dilation of the cardia or a stricture, there should be no delay in investigating the possibility by means of roentgenography and esophagoscopy.

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11. Fletcher, C. M., and Jones, F. S.: The Risks of Gastroscopy with a Flexible Gastroscope, Brit. M. J. **2**:421-422, 1945. Paul, W. D., and Antes, E. H.: Perforation of the Esophagus Caused by a Flexible Gastroscope, Rev. Gastroenterol. **13**:23-25, 1946. Paul, W. D., and Lage, R. H.: Perforation of Esophagus Caused by Flexible Gastroscope, J. A. M. A. **122**:596 (June 26) 1943. Pembleton, W. E.: Tension Pneumothorax from Rupture of the Esophagus, Virginia M. Monthly **73**:331, 1946.

12. King, J. M., and Strus, G. D.: External Perforation of the Esophagus, Am. J. Surg. **58**:448-449, 1942.

Surgical management consists of the immediate treatment of shock, if it exists, followed as soon as the patient's condition permits by exposure of the site of perforation and the establishment of a type of drainage which not only will adequately decompress the contaminated space but also will assure the free escape to the surface of the air and fluids that may subsequently leak from the area of perforation. This requirement is met most successfully by means of continuous suction through a sump type of drain, particularly in the cases of perforation of the thoracic esophagus. The cervical portion of the esophagus is exposed through an incision along the anterior border of the sternocleidomastoid muscle on one or both sides (if only one, preferably the left). If a rigid type of drainage tube is used, it must not contact the carotid artery. Hemorrhage from erosion of the artery by this means has been reported. As has been pointed out by Philips [13] and Wolcott [14] and others, drainage of both the retrovisceral space and the superior mediastinum can be accomplished through the cervical approach, but on occasion a dorsal mediastinotomy may be preferable for drainage of the superior mediastinum. The posterior mediastinum is approached perivertebrally through a lower dorsal mediastinotomy or, in the case of involvement of the pleural cavity, transpleurally through a thoracotomy. It is desirable to close the hole in the esophagus with sutures despite the fact that it usually reopens. Even temporary stoppage of the leak is beneficial.

Large doses of penicillin and streptomycin should be given immediately and continued for several days. There should be nothing taken by mouth for a week or more, that is, until the perforation is completely or at least partially closed and a securely walled-off sinus tract established. Water balance and nutrition may be maintained through a Levin tube threaded past the perforation and into the stomach at the time of operation or by intravenous administration. The benefit of gravity should be taken advantage of. In cases of perforation of the cervical portion of the esophagus the head down position is maintained and in cases of tears of the thoracic portion a sitting posture.

There is usually an esophageal fistula which closes rather promptly, and healing usually takes place without stricture. In 2 of our cases follow-up studies demonstrated the presence of diverticuli one of which may have resulted from the injury but cannot be definitely attributed to it in the absence of previous esophagrams.

The 5 cases which form the basis of this report may be summarized as follows. In 3 cases the perforation involved the cervical portion of the esophagus. Perforations occurred in all during esophagoscopy, in 2

13. Philips, C. E.: Mediastinal Infections from Esophageal Perforations, J. A. M. A. **111**:998-1004 (Sept. 10) 1938.

14. Wolcott, C. C.: Periesophagitis, Laryngoscope **57**:45-56, 1940.

accidentally in the process of introducing the instrument and in the other one during an unsuccessful effort to remove a foreign body. In all 3 cases the endoscopist was immediately aware of the accident, but in only 1 was surgical drainage promptly established, and this patient recovered. The other 2 patients died, 1 without the benefit of surgical intervention and 1 after drainage and a tracheotomy performed after two days of conservative treatment.

In both cases in which the thoracic end of the esophagus was perforated the underlying lesion was a lye stricture. In 1 patient, a child, perforation was produced by a bougie and in the other by a rather unique type of instrumentation. This patient, a middle-aged woman, learned to use a catheter stretched over a wire stilet to push food past the area of stricture, and on the occasion which led to hospitalization she had forced it through the wall of the esophagus. She recovered with conservative therapy. In the child empyema developed after several critical days from rupture of the mediastinal abscess into the pleural cavity. Drainage of the empyema and gastrostomy for feeding and subsequent retrograde dilation resulted in a cure.

## REPORT OF CASES

CASE 1.—K. T., a white woman of 54, entered the Bishop Clarkson Hospital as an outpatient on Oct. 17, 1947, for esophagoscopic investigation of increasing dysphagia of six months' duration. As the esophagoscope passed just beyond the level of the cricoid cartilage, a tear in the posterior wall was observed. The instrument was immediately withdrawn and the patient sent to the x-ray department. Roentgenograms (fig. 1) demonstrated interstitial emphysema of the tissues of the neck, with displacement forward of the esophagus by air in the retrovisceral space.

Within one hour the patient complained bitterly of pain extending from the base of the neck to the occiput and stated that it was made worse with swallowing and on inspiration.

Five hours after the accident drainage was established through an incision along the anterior border of the left sternocleidomastoid muscle. Infiltration anesthesia with procaine hydrochloride was used. The periesophageal tissues contained some air and blood and considerable edema, and in the posterior wall of the esophagus there was a transverse tear 1 cm. long. This was closed with interrupted sutures of 000 chromic surgical gut, and two soft rubber cigaret drains were placed and the wound left wide open. One drain was directed through the thoracic inlet into the superior mediastinum.

Convalescence was essentially uneventful. There was much substernal and interscapular pain and a febrile course for nine days, with a maximum temperature of 102 F. on the fourth and fifth days. For seven days all fluids and nutriment were administered intravenously and 1,200,000 units of penicillin were given daily.

On the eighth postoperative day the drains were removed and liquids were given by mouth and on the following day a soft diet. For three days there was some leakage through the wound and then the fistula closed permanently. Two months after the wound had healed the patient still complained of some "sticking of food" in the neck, and roentgenologic studies of the esophagus revealed a small pharyngeal-esophageal diverticulum.

*Comment.*—Undoubtedly, early decompression and drainage combined with vigorous antibiotic therapy were responsible for a cure in this case. The finding of an esophageal diverticulum in the follow-up roentgenograms raised the question whether the diverticulum existed prior to esophagoscopy and caused the original symptom of dysphagia or whether it developed from the injury.

Case 2.—W. S., a white man aged 35, was admitted to the Nebraska Methodist Hospital on Dec. 8, 1942, for the relief of dysphagia of one year. For one week all solid food seemed to stick in the distal end of the esophagus and caused distress until it was vomited. Physical examination and routine laboratory studies revealed no abnormal findings. Barium taken by mouth showed pronounced spasm of the distal end of the esophagus, with considerable delay of the barium in entering the stomach. There was no dilatation, irregularity or filling defect discerned in the esophagus, and the stomach and duodenum appeared to be normal.

An esophagoscopic examination was undertaken, but the patient was tense and did not cooperate well. Resistance was encountered at the level of the cricoid, and the obturator was inserted in an effort to guide the esophagoscope past the point of resistance. The endoscopist then observed a perforation in the

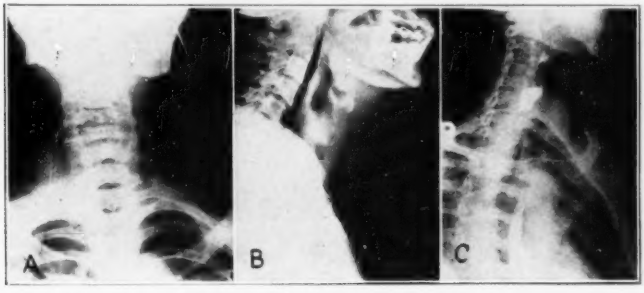


Fig. 1 (case 1).—*A* and *B*, one hour after perforation of the cervical portion of the esophagus. Note interstitial emphysema and the air-filled retrovisceral space, with anterior displacement of the esophagus. *C*, three months after perforation this esophageal diverticulum was demonstrated.

posterior wall, just above the cricopharyngeus muscle. The esophagoscope was immediately removed, and a roentgen examination revealed air in the tissues in the retropharyngeal region extending from the first cervical to the first dorsal vertebra (fig. 2).

The foot of the patient's bed was elevated, and he was given nothing by mouth. Sodium sulfathiazole (4 Gm.) was administered intravenously every eight hours, and from 2 to 3 liters of fluids were given parenterally daily.

Roentgenologic examinations on the second, fourth and sixth days following esophagoscopy showed increasing swelling in the retropharyngeal space and on the last examination a pocket of air surmounting loculated fluid.

From the time of the accident until his death, the patient complained of pain in the neck and an increasing choking sensation. He was extremely restless and apprehensive. The temperature had a daily excursion from normal to 101 F., and the respiratory rate remained essentially normal. Daily leukocyte counts ranged between 20,300 to 31,200.

The demonstration of fluid in the retrovisceral space in the roentgenograms made on the sixth day led to a decision to drain this space, but before this was

done the patient suddenly became cyanotic and died after a few minutes of asphyxia. An emergency tracheotomy was done without benefit. Permission for postmortem examination was refused.

*Comment.*—The infection in this case appears to have been confined to the retrovisceral space, and unquestionably death could have been averted by early drainage. Without a postmortem examination, one can only speculate regarding the cause of death. From the clinical evidence, it would appear that the abscess ruptured into the pharynx and the patient was asphyxiated from aspirating the pus.

CASE 3.—J. W., a Negro aged 39, entered the University Hospital on Dec. 4, 1945, forty-eight hours after swallowing a chicken bone. On admission his temperature was 102.6 F. and he complained of much pain in the neck and the upper portion of the chest. He stated that immediately after swallowing the bone there was pain in the right side of the neck and much distress with swallowing.

Roentgenograms of the neck revealed a fragment of bone in the esophagus at the level of the suprasternal notch, with air in the periesophageal tissues. On the day of admission an unsuccessful attempt was made to remove the foreign body by esophagoscopy. During the next twenty-four hours the temperature rose

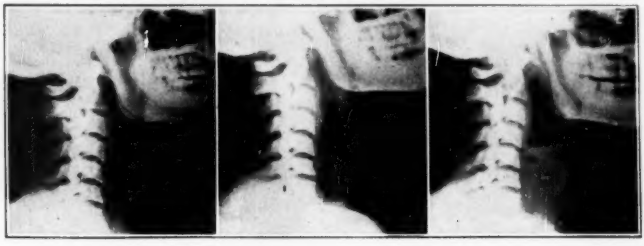

Fig. 2 (case 2).—Roentgenograms two hours, two days and six days after perforation of the cervical portion of the esophagus. Note progressive increase in extravasated air and widening of the space between the vertebral bodies and the esophagus and the final evidence of an air and fluid-containing abscess as indicated by the appearance of a fluid level.

to a level above 104 F., where it remained until death occurred two days later. The patient was toxic, and increasing difficulty in breathing developed to the point of strangulation, which was averted by introducing a bronschoscope into the trachea while a tracheotomy was being performed. The retrovisceral space and superior mediastinum were drained at the time of the tracheotomy. There was constant moderate leukocytosis, but blood cultures were sterile.

From the beginning, fluids were withheld by mouth and an adequate intake given parenterally. Moderate doses of sodium sulfadiazine and penicillin were also administered from the time of admission.

Roentgen reexamination on the day after admission and after a swallow of barium (fig. 3) disclosed no change in the location of the foreign body. The space between the esophagus and the vertebral bodies was increased, and there was a triangular area of density of air just posterior to the foreign body as well as a bulge in the soft tissues at the base of the neck in the anterior-posterior view. A roentgenogram of the chest showed displacement of the left lung laterally by air in the mediastinum extending from the apex to the eighth rib posteriorly.

Death occurred on the fourth day in the hospital and postmortem examination revealed an esophageal diverticulum extending from the pharyngeoesophageal

junction to the root of the lung and a chicken bone at the neck of the diverticulum, with performation of the left posterior wall of the esophagus. There were also mediastinal abscesses involving both the superior and the posterior part of the mediastinum, bilateral empyema, purulent pericarditis and terminal bronchopneumonia.

*Comment.*—It is interesting that this patient had an esophageal diverticulum, which was probably responsible for arresting the chicken bone which perforated the esophagus. The evidence indicates that perforation had occurred prior to esophagoscopy and that there was a well established infection in the retrovisceral space and the mediastinum at the time of admission. It is doubtful, therefore, that drainage twenty-four hours earlier would have changed the outcome. The fatal delay in this case took place before hospitalization.

Case 4.—V. L., a white boy aged 2½ years, entered the University Hospital on April 29, 1942, dying from dehydration and bronchopneumonia. Five weeks previously he had swallowed lye and for three weeks had taken only fluids in decreasing amounts and had lost weight steadily. With hydration and oxygen

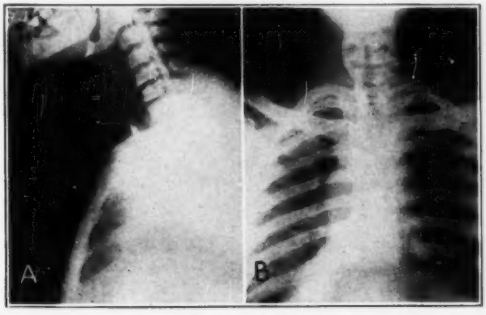


Fig. 3 (case 3).—*A*, the esophagus outlined with barium is displaced anteriorly, with a tissue density-filled retrovisceral space and a triangular area of air inferiorly surrounding the point of the chicken bone which protrudes through the posterior wall of the esophagus. *B*, in this roentgenogram note the swelling at the base of the neck on the left side and the lateral displacement of the left lung by air in the mediastinum.

there was rapid improvement, and in three days he was taking an adequate intake of liquids and soft food by mouth.

Six weeks later there was increasing evidence of esophageal obstruction, and on June 9 esophagoscopy demonstrated a stricture at the level of the thoracic inlet. On June 22 and July 27 the esophagus was dilated with bougies up to no. 20. Immediately after the second dilation there was considerable bleeding, and four hours later the patient had a temperature of 104 F. rectally, a pulse rate of 130 and rapid grunting respiration. He continued to be desperately ill, and within three days there were signs of fluid on the right side of the chest. This was confirmed by roentgenologic examination, which also revealed notable displacement of the trachea and heart to the left (fig. 4).

On Aug. 5, 1942, 400 cc. of thick foul-smelling fluid was removed from the right side of the chest. Gram-positive cocci and bacilli were demonstrated in smear and culture. Thoracenteses were repeated almost daily until closed drainage by thoracotomy was established on August 13. The pus removed from the chest contained curdled milk.

Four days after thoracotomy a Witzel gastrostomy was performed. The immediate convalescence was stormy, but after healing of the empyema and retrograde dilation of the stricture, the infant made a complete recovery.

*Comment.*—It is obvious that in this child the esophagus was perforated during dilation of the stricture, and it is reasonable to assume that an immediate mediastinotomy might have prevented the empyema and otherwise lessened the morbidity.

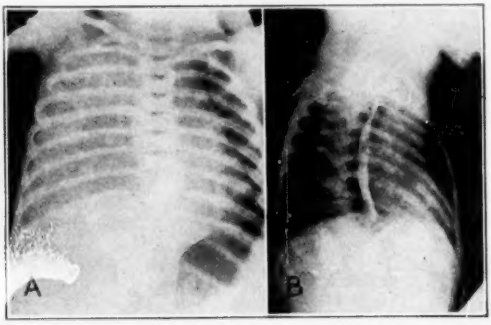


Fig. 4 (case 4).—*A*, mediastinitis and empyema on the left side following rupture of a strictured esophagus during dilation. *B*, esophagram after recovery following drainage of the empyema. Note the stricture in the proximal thoracic portion of the esophagus.

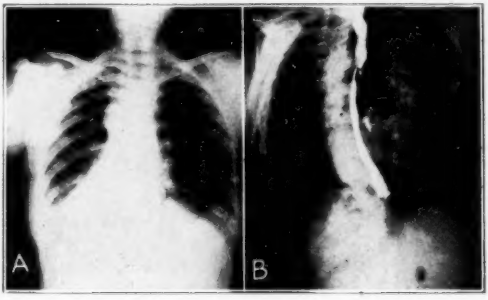


Fig. 5 (case 5).—*A*, this roentgenogram, made a few hours after a self-inflicted perforation of the thoracic portion of the esophagus, shows interstitial emphysema of the neck and evidence of bilateral basal atelectasis with small quantities of fluid in both costophrenic sinuses. *B*, in this esophagram after recovery from the mediastinitis resulting from perforation there appears not only the stricture at the junction of the upper and middle thirds but also barium outside of the esophagus, presumably in a sinus tract in the mediastinum and a residue of the perforation.

Case 5.—S. C., a white woman aged 59, was admitted to the University Hospital on Jan. 31, 1946. At the age of 4 she had swallowed lye, and on many occasions since then food had impacted at the area of stricture. She stated that when this occurred she was usually able to force the food down by swallowing

a soft rubber catheter. Three months previously a plum seed which could not be dislodged was removed by esophagoscopy. A few hours prior to her admission to the hospital a piece of meat failed to pass the stricture, and while attempting to force it down with a catheter stretched over a wire stilet she experienced a sudden sharp pain in the precordium and right flank and much dyspnea.

Roentgen studies (fig. 5) revealed air in the soft tissues of the neck and consolidation or atelectasis in the bases of both lungs. Conservative treatment with parenterally administered fluids and large doses of penicillin was carried out, with complete recovery after twenty-nine days in the hospital. The patient was extremely ill for ten days, with temperatures to 104 F. and much respiratory distress. There were no significant laboratory findings except a leukocyte count of 17,400 on admission.

Serial roentgenograms revealed regression of air in the soft tissues and clearing of the consolidation of the lungs. An esophagram on the twenty-seventh day in the hospital demonstrated a constriction of the esophagus at the level of the bifurcation of the trachea, with a fistulous tract or a diverticulum extending inferiorly from its anterior portion. At the time of discharge from the hospital she was able to swallow soft foods without difficulty.

*Comment.*—This patient is of interest in respect to both the mechanism of perforation and the recovery without surgical intervention. Also of interest is the presence of barium in a sinus tract or diverticulum leading inferiorly from the lumen of the esophagus at the site of stricture in the follow-up esophagram.

## DISCUSSION

DR. C. J. HUNT, Kansas City, Mo.: I should like to report a case of rupture of the esophagus not due to intraesophageal trauma but due to external trauma from an automobile accident.

One can see how an automobile accident can produce serious trauma to mediastinal structures, namely, vessels and so on, but it is difficult to see how external trauma can rupture an esophagus.

A middle-aged man was in an automobile accident. After the accident he did not seem to be severely injured. There were no external evidences of trauma. He returned to his place of business, a night club. He did have some pain at the time of the accident, located in the upper part of the abdomen or just below the lower part of the sternum. This passed off, but it returned after he reached his place of business. He thought he would relieve himself by drinking several bottles of beer, which he did. That did not give him satisfactory relief, so he took a couple of highballs. That did not give him relief either.

A physician was called, and he gave the man two injections of morphine, each about ¼ grain (0.02 Gm.). Later he was brought to the hospital. At that time he was comfortable and did not seem to be in distress. No evidence of external trauma could be found, and on examination there was no evidence of any serious internal injury.

Subsequently, roentgenologic examination was carried out. Air was found to be distributed in the mediastinum, and a barium picture was made. Some barium was swallowed. (Slide) Here the esophagus is visualized. You see the esophagus compressed to one side at this point and free air outside of the esophageal tract. This region was explored. A longitudinal rent was found in the lower portion of the esophagus, which I understand is the type of rent that occurs from external violence or from an injury to the esophagus not occurring from intraesophageal manipulation. This was sutured.

There was evidence of an extreme amount of extravasation, beer and whisky, an extreme amount of edema, waterlogging of the tissues and mediastinitis. The wound was closed with a mattress suture of silk. The site was drained. The patient died in four days. Autopsy showed a spreading type of mediastinitis and infection of the pleural cavity. The sutures were still intact. The suction tube had not eroded the suture line.

The patient died from sepsis. This case illustrates the importance of always keeping in mind the possibility of severe internal injury even though the initial symptoms do not indicate it. The manifestation may be slow in developing. An injury of this nature could only occur from a sudden tension and change of mediastinal and intraluminal pressure. The injuries occurring from intra-esophageal instrumentation are, no doubt, more common than would appear from the report. The presentation by Dr. Bisgard has been most instructive and interesting.

Dr. Kellogg Speed, Chicago: I should like to report a case of a little different type of pathologic process resulting from this injury. It was a case of a man with a carcinoma near the lower end of the esophagus. The internist was treating him by dilation and, without his knowledge, perforated the esophagus. The point of the bougie went on down and perforated the cardiac end of the stomach and landed in the spleen.

The patient lived about four weeks without any great distress and finally died. At autopsy the tract that I have just described was perfectly evident. One could see where the bougie had gone down, and in the spleen was one large area of solitary metastasis, evidently implanted by the point of the bougie, growing rapidly. There was some local peritonitis, but the exact cause of death was not really ascertained.

The bougie or the dilation, in the case of carcinomatous constriction, may inseminate additional metastasis.

Dr. Thomas J. Kinsella, Minneapolis: Dr. Bisgard has called to our attention an important surgical problem which frequently is overlooked. Our medical colleagues are inclined to delay calling these accidents to our attention; Consequently, we see the patients hours afterward. They should be examined promptly, within the hour if possible, certainly as promptly as a patient with a perforated peptic ulcer.

I am in complete accord with what Dr. Bisgard has said. I believe in immediate operation for cervical perforations, with bilateral drainage of the retrovisceral space and the mediastinum. Chemotherapy alone will not take care of the larger perforations.

Another type of emergency which we should also recognize is the perforation in the lower part of the esophagus of more or less spontaneous type. It may follow insignificant trauma, such as from the passage of a stomach tube of soft type, but may occur as a completely spontaneous accident. It is prone to occur in postoperative vomiting and in pregnancy but more commonly in the patient who likes to overeat and overdrink, as an apparently spontaneous perforation.

It is an extremely serious condition. There is rapid development of shock; mediastinal emphysema occurs which, if it works upward, may be present in the supersternal notch. The condition must be recognized promptly. At least half of the patients reported on have been subjected to an exploratory laparotomy, without any result. The perforation is into the mediastinum and then into the pleural cavity, usually on the left. If roentgenograms are taken in the erect position a fluid level and a tension pneumothorax will be found. If you give

the patient a little grape juice to drink it will appear in the pleural fluid and can be recognized, confirming the perforation, as will the finding of gastric acids in the fluid.

You may treat the patients for shock for hours or days, but they will not come out of it. The tension pneumothorax must be relieved first, after which the patient must be operated on promptly in spite of the shock. He will come out of shock when the chest is explored, when the mediastinum is decompressed, the perforation of the esophagus closed and continuous drainage of the pleural cavity established.

It is a serious situation. We should think of it particularly when we have a case of suspected perforation of ulcer at hand, because the condition resembles perforation of a peptic ulcer and has been mistaken for it in the majority of instances.

Dr. Roger Vaughan, Chicago: I should like to add a word to this discussion of spontaneous perforations. I have seen 5 or 6 cases, and all the patients have died. Two of our staff members in the Cook County Hospital observed their first cases in private practice and did not recognize the symptoms because they did not know of the condition. The condition was diagnosed as perforated peptic ulcer, and of course a laparotomy was without value.

I do not consider these lesions at all difficult to diagnose. All those I have seen were in patients with chronic alcoholism. These patients have esophagomalacia in the lower end which is easily demonstrated at autopsy.

The outstanding feature which should help one to make the diagnosis, once one is aware that there is such a condition, is that in cases of perforated peptic ulcer the vomiting follows the perforation. The pain comes first and then the vomiting. With esophagomalacia, the perforation is caused by the violent vomiting, and then a sudden severe pain in the epigastrium follows.

Furthermore, in the cases of esophageal perforations there is not either the intense rigidity of a perforated peptic ulcer or the completely silent abdomen, and if you look carefully for a pneumoperitoneum in these cases, you will see that instead of it there is fluid in the left pleura or in both pleurae, and if you turn the patients laterally you will see the air in the mediastinum and sometimes a fluid level too.

The main thing to keep in mind is that when you suspect perforated peptic ulcer and the patient vomits violently, the clue to diagnosis is: Did the vomiting come first or did the pain come first?

Dr. J. Dewey Bisgard, Omaha: I want to thank Dr. Hunt, Dr. Kinsella, Dr. Speed and Dr. Vaughan for their splendid additions to this discussion and refer any one interested to the article by Dr. Kinsella in the current issue of the *Journal of Thoracic Surgery* for a complete discussion of spontaneous perforations.

There is a certain advantage in instrumental perforations in that there is usually knowledge that a perforation is present. The endoscopist sees the perforation develop, and in other instrumental perforations there is usually evidence within a few hours, in the form of fever and pain, that the perforation has occurred. With this advantage there is no excuse for not establishing drainage early, except for the delay in receiving surgical consultation. Too often we see the patients late, and the mortality is more or less inversely proportionate to the time that elapses before drainage is established.

The main purpose of my paper is to emphasize the need of early diagnosis and the establishment of drainage immediately or within a few hours after perforation occurs.

# HEMIHEPATECTOMY WITH HEPATICOJEJUNOSTOMY FOR IRREPARABLE DEFECTS OF THE BILE DUCTS

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MEMPHIS, TENN.

OF THE numerous methods of repair of defects of the bile ducts, the two which are generally considered most dependable are direct end to end anastomosis of the distal and proximal segments of the duct and anastomosis of the proximal portion to the duodenum or jejunum. The first of these procedures is obviously the method of choice and, when the defect is short, is usually applicable. For strictures limited to the ampullary region with dilatation of the duct above, a choledochoduodenostomy or choledochojejunostomy affords an effective and physiologic means of overcoming the obstruction.

In the presence of extensive destruction of the ducts, the problem is far more serious. Within recent years, hepaticojejunostomy with a supplementary enteroenterostomy, as suggested by Allen [1] and by Warren Cole,[2] has gained wide acceptance as a logical solution. After these procedures, however, one is confronted with the possibility of stricture at the site of the hepaticojejunostomy, with consequent obstruction of the flow of bile and progressive hepatic damage.

Longmire [3] has recently described an operation which he has employed with success in a case of extensive acquired stricture of the extrahepatic ducts after two attempts by other means had failed. His operation consisted of upward dissection of the left lobe of the liver until a suitable duct for anastomosis to the jejunum was found, resection of a wedge-shaped segment of the left lobe in this area, coring out of the liver about the duct to provide a sufficient length for reconstruction and anastomosis of the end of the duct to a small opening into the side of the jejunum over a short rubber tube. The anastomosis was reenforced by suture of the antemesenteric border of the jejunum to the superior surface of the liver capsule along the cut edge. A sup-

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 3, 1948.

1. Allen, A. W.: A Method of Reestablishing Continuity Between the Bile Ducts and Gastrointestinal Tract, Tr. South. S. A. **61**:28, 1944.

2. Cole, W. H.; Irencus, C., Jr., and Reynolds, J. T.: Use of Vitallium Tubes in Strictures and Absence of the Common Bile Duct, Ann. Surg. **122**: 490, 1945.

3. Longmire, W. P., Jr., and Sanford, M. C.: Intrahepatic Cholangiojejunostomy with Partial Hepatectomy for Biliary Obstruction, Surgery **24**:264, 1948.

plementary enteroenterostomy was then made. Fortunately, as he pointed out, the periductal fibrosis thickens the duct wall so that it is well adapted to suture and the back pressure incident to obstruction dilates the duct to a size adequate for anastomosis. In this operation, Longmire clearly demonstrated a ductal communication from the right to the left lobe sufficient to provide ample bile drainage, thus substantiating previous experimental evidence of an interlobal connection of the ducts.

I am reporting herein the case of a patient with irreparable destruction of the bile ducts who was treated by hemihepatectomy and hepaticojejunostomy in a manner similar to that suggested by Longmire.

The patient, a woman aged 23, had been subjected to cholecystectomy elsewhere eight months previously. She had become jaundiced soon after the operation, and one month later the surgeon had inserted a tube for drainage. At the time of her first visit the tube was still in situ and was draining bile-stained fluid almost continuously. She was having episodes of chills and fever at frequent intervals, had lost 20 pounds (9.1 Kg.) in weight and had been in bed most of the time since the operation.

On examination the patient was rather severely jaundiced and showed evidence of loss of weight. The liver was enlarged, and tenderness was elicited in this region The icterus index was 45, the prothrombin time was 37 seconds and the direct van den Bergh reaction was positive. It was apparent from the history and these findings that the common duct had been damaged surgically and that operative repair would be necessary. After preparation with several blood transfusions, the administration of vitamin K and other measures, the operation was undertaken under spinal anesthesia.

When the abdomen was opened, the common duct was identified with difficulty because of extensive adhesions secondary to the former operation. A segment 1½ to 2 inches (3.8 to 5 cm.) in length had previously been removed from the duct. The distal portion was so short that an end to end anastomosis with the proximal portion was impossible, and it was left undisturbed. The proximal portion had sloughed away up into the hilus of the liver, and a complete stricture in this area had produced a large bile cyst. After removal of the contents of the cyst, the segment was united to the jejunum by the Allen technic, i. e., the jejunum was divided about 12 inches (30.5 cm.) below the ligament of Treitz, the distal end drawn over the transverse colon, the mucosa invaginated and the serosa sutured to the hilus of the liver around a tube inserted into the stump of the duct. The tube, which was bell shaped at the upper end and contained an opening within the lumen of the jejunum for passage of the bile, was brought out through the side of the jejunum and through the abdominal wall. The proximal portion of the jejunum was anastomosed to the distal segment as a Roux Y procedure, thus reestablishing the continuity of the intestinal tract.

The patient's progress was satisfactory after this procedure; the jaundice cleared, and the wound healed. Two weeks after her discharge from the hospital, however, a digestive disturbance developed and she again became jaundiced. She was given medical treatment but continued to have difficulty; the chills and fever recurred, the icterus index rose steadily and the liver increased in size. Eighteen months postoperatively she began passing blood through the intestinal tract, presumably incident to obstruction of the duct at the site of anastomosis, though some bile was still present in the stools. She was given blood transfusions

and again treated medically, with temporary benefit. The chills, fever and jaundice then increased, the icterus index reached 100, the stools became colorless and the enlargement of the liver grew pronounced. Since the obstruction was now apparently complete, surgical treatment was again recommended. Two years had elapsed since the first reconstructive procedure.

After thorough preparation of the patient, the upper part of the abdomen was opened and, as on the previous occasion, was found filled with adhesions. Both lobes of the liver were enormously enlarged and firm. The jejunal loop which had been utilized as a substitute for the common duct had contracted at the

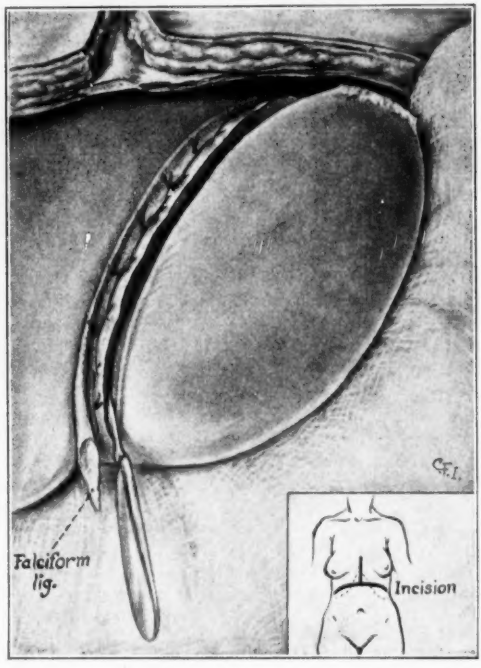


Fig. 1.—Inverted T type of incision (insert). Through this incison the triangular ligament was severed and the liver easily brought into the wound. Hemostatic mattress sutures of heavy surgical gut have been placed along the falciform and round ligaments. Resection is begun at the posterior surface and brought toward the anterior surface of the liver.

site of anastomosis in the hilus of the liver and produced complete obstruction. It was severed at this point and resected for a distance of 2 inches (5 cm.). The hilus was then spread with forceps, which opened a large cavity filled with bile and containing several small stones. The cavity having been evacuated, a search for the ends of the ducts was made with a probe, but none could be found in either the right or the left lobe. There was simply a large opening in the hilus of the liver. The bell end of a no. 14 catheter was therefore sutured in

the hilus, and the tip was brought out through the jejunum 10 inches (25 cm.) below and thence through the abdominal wall. The jejunum was then sutured to the edge of the liver all around the tube, without inversion of the mucosa. Other drains were inserted to the hilar region and brought out through a stab wound.

The bile drained well, and the patient made excellent progress for about six weeks. At that time, cramping pain in the abdomen developed, and she had a mild chill with fever. A few days later she began vomiting blood and passing blood through the bowel, and she again became jaundiced. Examination

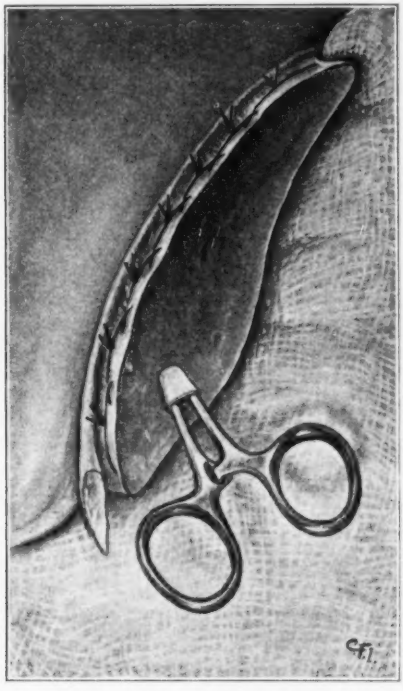

Fig. 2.—The entire left lobe of the liver has been removed and hemorrhage controlled by mattress sutures. The large left hepatic duct has been freed for nearly 2 inches (5 cm.) and a 7½ inch (19 cm.) forceps inserted into the duct, which demonstrates its depth and probabe connection with the right side.

showed the liver still enlarged, the left lobe more so than the right. The icterus index was 23. She was given transfusions and given medical treatment, but she returned five weeks later with abdominal distention, further enlargement of the liver and an icterus index of 55. The stools, however, were still slightly colored. It was evident that more drastic measures would be necessary in order to provide a better outlet for the flow of bile, which had been obstructed for so long by recurrent strictures at the hilus of the liver. With the experimental and surgical evidence of an interlobal communication of the ducts reported by

Longmire as a background, it was decided to remove the entire left lobe of the liver, isolate the left hepatic duct, determine its communication with the right lobe and anastomose the end of the left duct to the side of the jejunum.

Five and one-half months after the preceding operation, the abdomen was reopened transversely at the costal margin, with division of the rectus muscles and a supplementary midline incision, which formed a T-shaped approach. Both lobes of the liver were tremendously enlarged, the left slightly more than

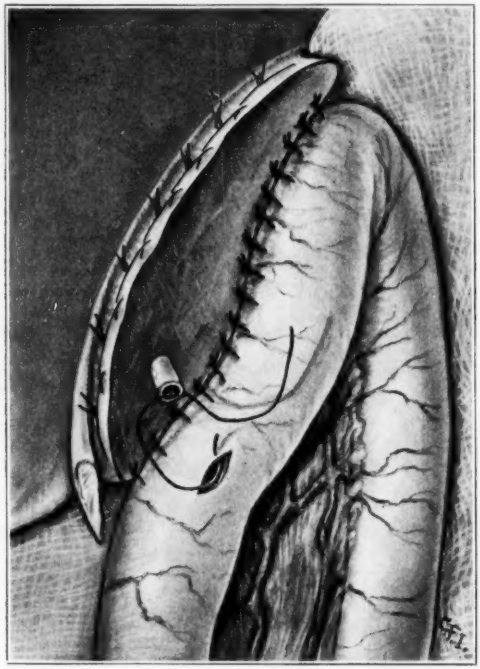

Fig. 3.—The first step of the anastomosis of the open end of the left hepatic duct to the antemesenteric surface of the jejunum. Mucosa to mucosa anastomosis is done with interrupted sutures of fine surgical gut. The jejunal loop is attached to the under surface of the liver by interrupted sutures of fine silk preparatory to being folded over as the final step of the operation, shown in figure 4.

the right. The spleen was 2½ times normal size. The triangular ligament of the left lobe was severed and the lobe elevated. The dividing line between the right and left lobes was found, and mattress sutures were inserted with long straight needles through and through the liver to control the hemorrhage. The left lobe was then removed. The loss of blood was considerable, but it was satisfactorily controlled by continuous suture of the borders of the liver with surgical gut in addition to the mattress sutures previously applied. The left hepatic duct was isolated as the lobe was being removed, and a segment about

2 inches (5 cm.) long was freed to be used for the anastomosis. A large artery along the under surface of the hepatic duct was ligated by suture around the artery at the border of the duct. After this procedure, an artery forceps was inserted 4 or 5 inches (10 to 12 cm.) into the open end of the left duct, which demonstrated a definite communication between the right and left lobes. At this point, bile escaped freely from the open duct; since the left lobe

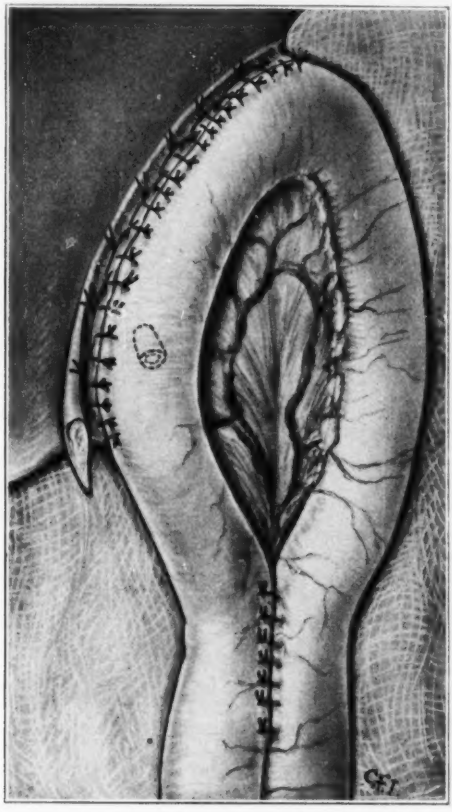

Fig. 4.—Anastomosis of the open end of the left hepatic duct to the jejunum as an end to side anastomosis. The operation is completed by suture of the jejunum to the anterior surface of the liver with interrupted sutures of fine surgical gut. Enteroenterostomy is performed about 6 inches (15 cm.) below, as a precaution against regurgitation of the intestinal contents into the left hepatic duct.

had been removed, it was evident that the bile came from the right side. The duct was surprisingly large, being almost the size of the average fountain pen, and its walls were thick and fibrous, thus lending themselves well to suture.

The loop of the small intestine just proximal to the former Roux Y anastomosis was next brought through the transverse mesocolon at the hepatic flexure and sutured to the end of the hepatic duct as an end to side anastomosis. Since the duct was sufficiently large to permit suture of mucosa to mucosa, an indwelling tube was unnecessary. To prevent traction on the anastomosis, the jejunum was sutured to the cut surface of the liver for a considerable distance on both sides of the anastomosis. A lateral enteroenterostomy was then performed just below this point. Finally, as a further precaution against slipping, the transverse mesocolon was sutured to the limb of the bowel at its emergence

Fig. 5.—Photograph of patient four months postoperatively, showing evidence of gain in weight and complete healing of the wound. The previously enlarged liver has almost returned to normal size.

from the mesocolon. It was believed that the bile would now pass freely through the new anastomosis. The previously made hepaticojejunostomy opening (Allen operation) to the right lobe was not disturbed. Since a small amount of drainage from this lobe had persisted, the hepatic damage was not considered too severe to prevent recovery. The abdomen was thoroughly cleansed, and, in order to hasten convalescence, closure was completed without drainage. Since the hepatic wound seemed dry, the omission of drains appeared to be perfectly safe. Transfusions consisting of a total of 2,000 cc. of whole blood were given throughout the operation.

The patient's convalescence was complicated by the development of bile peritonitis. Closure without drainage had been an error. After the institution of drainage, however, the peritonitis promptly cleared and she had no further difficulty. At the time of her discharge from the hospital, the jaundice was much less noticeable, the icterus index was lower, the right lobe of the liver had diminished in size and her general condition had improved.

Since leaving the hospital, she has been seen every few weeks. The chills and fever have not recurred, which indicates that she has been free from ascending infection, and the hepatitis has continued to subside. The duct and the anastomosis have remained patent, as shown by the fact that she has passed the usual amount of bile through the intestinal tract.

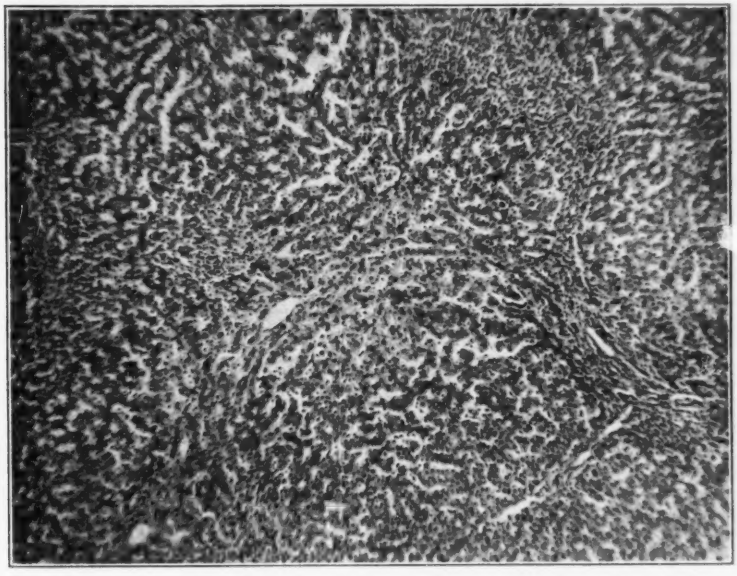

Fig. 6.—Photomicrograph of pathologic section showing distortion of liver lobules by increased connective tissue. The connective tissue is moderately infiltrated by lymphocytes. The diagnosis is early biliary cirrhosis.

At the last observation, Nov. 23, 1948, she reported that she was feeling much improved, was taking a well balanced diet, had gained strength and was doing her housework. Her skin was still a little icteric, though the bowel function was regular and the stools a normal brown color. She weighed 120 pounds (54 Kg.), which represented a gain of 20 pounds (9 Kg.) since the operation.

Physical examination showed that the wounds had healed without the occurrence of hernias. No mass was palpated in the region formerly occupied by the left lobe of the liver. The right lobe had receded and was practically normal in size; it could be palpated at the rib margin just beneath the right angle of the scar but was not tender. There was a slight fulness in the upper abdominal area, probably incident to the crowded tissues in the region of the last anastomosis. The continued slight jaundice was believed to be secondary to the poorly drained portion

of the right lobe through its normal hilus where the Roux arm (Allen operation) was last attached.

The patient stated that she was well pleased with the result as compared to her former condition. It had been approximately three years since the first operation (Dec. 12, 1945), and her condition was better than it had been at any time since the cholecystectomy was performed elsewhere several months earlier.

The report on the pathologic study of the specimen of liver was as follows:

*Gross Appearance.*—The specimen consists of approximately the left lobe of the liver, measuring 20 by 12 by 6 cm. Its external surface has a mottled brownish and purple color. Serial sections reveal a yellowish green color, which is uniform and diffuse throughout. There is no coarse nodularity on either its external or cut surfaces, though the consistency is relatively firm throughout.

*Microscopic Appearance.*—Several sections present essentially the same appearance. The liver nodules are moderately distorted, incident to increased fibrous connective tissue, chiefly between and in the portal triads. Within this collagenous tissue there is a moderate but diffuse infiltration of lymphocytes and occasional macrophages. Within the liver lobules are scattered foci showing many canaliculi distended with a brown pigmented material; otherwise, the parenchyma is not remarkable. There is some proliferation of the small bile ducts in the fibrous stoma.

*Diagnosis.*—The diagnosis is early biliary cirrhosis.

### COMMENT

This case is reported because of the unusual features and because the demonstration of an interlobal communication of the ducts seems to substantiate the views expressed by Longmire. Technically, the operation described is most difficult and the risk is great. The most serious problem is the danger of hemorrhage, though this can be overcome by the use of continuous transfusion. Fortunately, the indications for surgical measures of such magnitude are rare. Desperate conditions, however, require desperate means, and when one has no other recourse, as in this case, the procedure is justified.

## DISCUSSION

DR. WARREN H. COLE, Chicago: First, I wish to state that I consider this operation to be useful in certain cases, particularly those in which one is unable to find the stump of duct at the hilus. I intend to utilize it but as yet have had no occasion to do so.

I also want to make my position clear about the use of tubes of various types. I believe that tubes should not be put in the common duct to remain permanently. I am convinced of that. I think probably Dr. Sanders feels he would not use them at all, but I do think that some sort of support is indicated in most of the anastomoses which one makes between a bile duct and some other structure such as a loop of jejunum. I feel that if this tube is left in place for eight to twelve weeks the stenosis associated with cicatrization will be minimized much more than if no tube is used. True enough, we do not have good experimental data to back up that statement. I may not be correct in it, although I do believe that most surgeons working in this field feel that some sort of support is desirable.

Dr. Sanders has kindly referred to an operation which my associates and I reported recently. This operation was designed for patients in whom stricture had formed at the hilus of the liver. I am sure those of you who are doing these

operations agree with me in identifying the hilus as the site where most of the strictures occur, particularly if one or two attempts have already been made at repair. We have long since discovered that at numerous areas throughout the body we counteract the stenosing effects of cicatrization by grafts. For this reason we devised a method in which we utilize a cuff of mucosa and submucosa on the end of an arm of jejunum as a graft to insert into the scarred area at the exit of the bile duct in the hilus of the liver. We have performed this operation on only 4 patients but have been very pleased with its results up to date.

As I intimated previously, I had 2 patients on whom I thought I would do the Longmire procedure which Dr. Sanders is reporting. In spite of the fact that we made free use of a syringe and needle, which usually is successful in finding the duct, we were unable to locate it in these 2 patients. We had already utilized so much operating time that we did not believe adoption of another procedure would be justifiable. We closed the abdomen (with a Penrose drain at one end), expecting later to reoperate on them and utilize the Longmire technic. However, we were somewhat surprised that a free flow of bile was established in forty-eight to seventy-two hours in both of the cases. Apparently bile precipitate had plugged our needle, thus preventing aspiration of bile, but we had made so many perforations in the duct that drainage of bile took place spontaneously. Accordingly, we reoperated on the patients, utilizing our mucosal graft technic previously referred to.

I wish to reiterate that this procedure on which Dr. Sanders has reported is a definite contribution, particularly when one is unable to find the duct. On such occasions it may be very useful.

Dr. Thomas G. Orr, Kansas City, Kan.: I do not want you fellows from the north to think that I am going to criticize the way this subject was presented or what was presented. It was a magnificent case report by this gentleman with "egg on his vest." If I have a case like this I am going to operate exactly as he did, with one exception. I am not going to use a loop of jejunum, but I am going to cut it in two and use the Roux Y method instead of the loop of jejunum.

I have little confidence in the so-called Braun anastomosis from one loop of the jejunum to another. I do have much confidence in peristalsis, and I think that it is a deceptive measure to use an enteroanastomosis when you are draining something and do not want the intestinal content to go past that point of drainage.

Dr. R. L. Sanders, Memphis, Tenn.: In answer to Dr. Jackson's question, we have had no occasion to try this procedure for congenital atresia of the bile ducts, though it has been our experience that the atresia extends so deeply into the liver substance that the operation would not be applicable. A few weeks ago I wrote to Dr. Robert Gross, of Boston, for his opinion, and he replied that he had tried the operation on infants but was never able to find a duct sufficiently large for anastomosis to the intestinal tract. He tried removal of a portion of the liver and suture of its raw surface to the open intestine, but this also failed.

Dr. Orr states that he would prefer using the end rather than the side of the jejunum for anastomosis to the hepatic duct. He has in mind the diversion of food from the hepatic duct to avoid ascending infection. Since I had already used the Roux operation in this case, I decided to make a lateral anastomosis, with an enteroenterostomy below. It is my impression that this will serve the purpose as well. For many years we have used a lateral anastomosis in uniting the gallbladder or common duct to the intestinal tract. I have recently looked up 45 of these cases, and they have been successful; none of the patients has had evidence of ascending infection. Possibly the answer is a wide anastomosis which will not stricture.

# GASTROJEJUNOCOLIC FISTULA

STANLEY E. LAWTON, M.D.
AND
ARTHUR R. MARKS, M.D.
CHICAGO

GASTROJEJUNOCOLIC fistula following gastroenterostomy for gastric or duodenal ulcer is seldom observed by the individual surgeon and appears relatively infrequently in the large clinics. To date slightly over 300 cases have been reported. The complication of a fistulous tract between stomach, jejunum and colon resulting from operation for peptic ulcer is a serious one. It exerts a marked effect on the nutritional state of the patient, its treatment requires major surgical procedures and the mortality incident to its occurrence is high. During the past twenty years, 22 patients with gastrojejunocolic fistula were admitted to the Veterans Administration Hospital, Hines, Ill. The purpose of this paper is to report a study of their cases, to add to the literature 2 cases with complications not known to have been previously described and to present 2 cases in which a new surgical procedure has been successfully employed.

The average age of our patients was 45 years. The youngest patient was 32 and the oldest 54 (table 1). The average age at the time of the original operation for ulcer was 34. The youngest was 24 and the oldest 52 (table 2). A history of ulcer for periods of from eighteen months to thirty-one years antedated these operations. Although duodenal exclusion procedures of Finsterer and Devine are considered conducive to formation of marginal ulcers, none of the patients in our series had been subjected to these operations. Twenty-one of the 22 had undergone posterior gastroenterostomies, and in 1 patient an anterior anastomosis had been performed. Considerable difference was found in the time interval between the original anastomosis and the onset of symptoms attributable to presence of a fistula. This varied from eight months to twenty-two years, with an average lapse of time of six years and two months (table 3). Similar variations have been previously noted.

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Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 3, 1948.

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Permission for publication has been granted by the Chief Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors.

Ransom [1] reported a variation of from one to twenty-six years, with an average of nine years and six months, and Langemeyer [2] recorded 1 case in which a fistula developed forty years after gastroenterostomy.

Diagnosis was made in the majority of our cases from the history and confirmed by the other findings. All 22 patients gave histories of

TABLE 1.—*Age Incidence*

| Age, Years | No. of Cases |
|---|---|
| 20 to 29 | 0 |
| 30 to 39 | 4 |
| 40 to 49 | 13 |
| 50 to 59 | 5 |
| Youngest patient | 32 |
| Oldest patient | 54 |
| Average age | 45 |

TABLE 2.—*Age at Time of Original Operation for Ulcer*

| Age, Years | No. of Cases |
|---|---|
| 20 to 29 | 8 |
| 30 to 39 | 8 |
| 40 to 49 | 4 |
| 50 to 59 | 2 |
| Youngest patient | 24 |
| Oldest patient | 52 |
| Average age | 34 |

TABLE 3.—*Time Between Original Operation and Onset of Symptoms of Fistula*

| Time, Years | No. of Cases |
|---|---|
| Less than 2 | 5 |
| 2 to 4 | 7 |
| 5 to 9 | 4 |
| 10 to 15 | 5 |
| Over 15 | 1 |
| Longest interval | 22 yr. |
| Shortest interval | 8 mo. |
| Average interval | 6 yr. to 2 mo. |

typical ulcer symptoms, failure of medical management and subsequent gastroenterostomy. After operation they had experienced a period of relief, after which abdominal pain, diarrhea, loss of weight and weakness appeared (table 4). The pain was of two types. Four of the patients complained of an initial periumbilical distress, more pronounced

1. Ransom, H. K.: Gastrojejunocolic Fistula, Surgery **18**:177-190, 1945.
2. Langemeyer, cited by Thomas, J. R.: Gastrojejunocolic Fistula with Report of Five Cases, Mil. Surgeon **87**:232-238, 1940.

in intensity than that caused by their original ulcer. All patients complained of a less characteristic pain in the lower abdominal area of a type usually associated with obstruction of the small or large bowel. Presumably the pain in the first instance was due to presence of marginal ulcers, whereas the latter type of pain was of mechanical or inflammatory origin resulting from the presence of fistulous tracts. In view of the fact that marginal ulcer is a prerequisite to the development of gastrojejunocolic fistula, it seemed that the number having the type of distress characteristic of marginal ulcer was exceedingly low.

Loss of weight, weakness and malnutrition were present in all patients. The average loss of weight was 30.9 pounds (14 Kg.) and the maximum 54 pounds (24.5 Kg.). Malnutrition was extreme in 3 patients, considerable in 5 and moderate in 11.

TABLE 4.—*Symptoms*

| | No. of Cases |
|---|---|
| Pain—stomal ulcer type | 22 |
| Loss of weight | 22 |
| Weakness (malnutrition) | 22 |
| (*a*) extreme | 3 |
| (*b*) considerable | 8 |
| (*c*) moderate | 11 |
| Diarrhea | 22 |
| (*a*) severe | 17 |
| (*b*) moderate | 5 |
| Fecal eructations | 10 |
| Vomiting | 9 |
| Hematemesis | 1 |

Diarrhea was a constant finding and the most aggravating of all symptoms. Every one of the 22 patients complained of loose stools. These began as recurrent short attacks and increased in frequency until in several instances they occurred fifteen to twenty times daily. Eight patients complained of tarry or dark red stools early in the course of their illness, and 1 patient vomited bright red blood. Opinions regarding the cause of the constant finding of diarrhea have changed somewhat in recent years. At one time it was thought that rapid emptying of gastric contents into the colon was the causative factor. Pfeiffer,[3] however, observed fluoroscopically that barium passes extremely slowly from the stomach into the bowel, whereas passage in the reverse direction from colon to stomach takes place much more rapidly. He expressed the belief, therefore, that the diarrhea is initiated by regurgitation of the contents of the colon into the stomach and jejunum, which

3. Pfeiffer, D. B.: Surgical Treatment of Gastrojejunocolic Fistula, Surg., Gynec. & Obst. **72**:282-289, 1941.

in turn induces a hyperperistalsis in the jejunum, with speedy emptying of the small bowel into the colon. Further support has been given to this opinion by Barber and Madden [4] and by Renshaw, Templeton and Kiskadden,[5] who recently demonstrated, in dogs and in patients, that ordinarily sufficient gastric content does not pass directly into the colon to bring about diarrhea.

Fecal eructations and vomiting are likewise important symptoms of gastrojejunocolic fistula. Ten patients gave fecal eructations and 9 vomiting as major complaints. Although fecal eructations and stercoraceous vomiting are frequently recorded in patients' charts, careful questioning often reveals the regurgitations and vomiting to be of fetid rather than fecal type. In only 5 of our patients was the vomiting definitely fecal. Duration of symptoms due to fistula prior to the patients' admission to the hospital averaged thirteen months. Three patients had symptoms for less than three months and 3 for more than two years (table 5).

TABLE 5.—*Duration of Symptoms of Fistula Prior to Time of Admission*

| Time, Months | No. of Cases |
|---|---|
| Less than 3 | 3 |
| 3 to 5 | 4 |
| 6 to 11 | 4 |
| 12 to 17 | 7 |
| 18 to 24 | 1 |
| Over 24 | 3 |
| Average | 13 mo. |

Anemia, with red blood cell counts of 1,500,000 to 3,500,000 and correspondingly low hemoglobin contents, was present in 15 of our patients. The anemias were of both a hypochromic and a macrocytic type. Blood serum protein levels, determined for 2 patients, were found reduced to 5.3 and 6.1 Gm. per cubic centimeters. Similarly low values were reported by Ransom [1] and by Atwater, Butt and Priestley.[6] Eighty-eight per cent of the patients from the Mayo Clinic had subnormal values, with an average serum protein level of 4.9 Gm. per hundred cubic centimeters. Other important findings, which commonly are present, are reduction of ascorbic acid and a prolonged clotting time due to disturbed absorption of vitamin K.

4. Barber, R. F., and Madden, J. L.: The Surgical Management of Gastrojejunocolic Fistulas, Surgery **22**:657-670, 1947.

5. Renshaw, R. J. F.; Templeton, F. E., and Kiskadden, R. M.: Gastrocolic Fistula, Gastroenterology **7**:511-515, 1946.

6. Atwater, J. S.; Butt, H. R., and Priestley, J. T.: Gastrojejunocolic Fistula with Special Reference to Associated Nutritional Disturbances and Certain Surgical Aspects, Ann. Surg. **117**:414-426, 1943.

Roentgenologic studies were carried out on all patients, and for 20 a correct diagnosis was made. For the other 2 patients a marginal ulcer was positively diagnosed, but some uncertainty existed concerning the presence of fistulous communication to the colon. Small tracts which permitted only slow passage of barium were later found at operation in both of these patients. As a rule the use of barium enemas is more advantageous in making a diagnosis than administration of a barium meal. Because of the greater rapidity with which the radiopaque material passes from the colon into the stomach and jejunum, it is much more easily visualized at that time than when it is passing more slowly in the opposite direction.

Treatment of gastrojejunocolic fistula is both medical and surgical. Before surgical treatment can be initiated, the acidosis, alkalosis, ketosis, avitaminosis and nutritional imbalances resulting from prolonged diarrhea, vomiting, loss of weight and dehydration must be overcome. In our patients several days to several weeks of treatment were necessary to reestablish as nearly as possible a chemical-physiologic balance. During this time, large doses of vitamins, intravenously administered dextrose and sodium chloride solution, low residue diets, enemas, blood transfusions and chemotherapy were given as indicated. The value of these procedures has previously been demonstrated. Gray and Sharpe [7] observed a drop in their mortality rates from 61.5 to 27.7 per cent after adoption of a nutrition-restoring preoperative program, and a 28 per cent reduction was reported by Coller.[8]

A variety of technics has been used in the surgical treatment of gastrojejunocolic fistula. Disconnection of the fistula, with restoration of normal continuity, was the operation of choice from the time of Czerny's operation on the first reported gastrojejunocolic fistula in 1903 until recent years. In an attempt to lower operative mortality, exteriorization of the transverse colon at the time of removal of the fistula was carried out by Mason and Baker [9] in 1931, and in 1935 Lahey and Swinton [10] reported an exclusion operation with an end to side gastrojejunostomy. Allen [11] subsequently devised an aseptic technic considered of value, and Findlay [12] utilized the Mikulicz principle by

7. Gray, H. K., and Sharpe, W. S.: Preoperative Management of Gastrojejunocolic Fistula, Arch. Surg. **43**:850-857 (Nov.) 1941.

8. Coller, F. A., in discussion on Pfeiffer and Kent.[14]

9. Mason, J. T., and Baker, J. W.: Gastrocolic Fistula, S. Clin. North America **11**:1097-1099, 1931.

10. Lahey, F. H., and Swinton, N. W.: Gastrojejunal Ulcer and Gastrojejunocolic Fistula, Surg., Gynec. & Obst. **61**:599-612, 1935.

11. Allen, A. W.: An Aseptic Technique Applicable to Gastrojejunocolic Fistula, Surgery **1**:336-348, 1937.

12. Findlay, F. M.: Treatment of Gastrojejunocolic Fistula by Multiple Stage Operations, Arch. Surg. **32**:896-906 (May) 1936.

exteriorizing the transverse colon and the segment of small bowel involved in the fistula. Scrimger [13] removed the mucosa from a gastric cuff about the fistula, closed muscularis to muscularis and subtotally resected the stomach. Successful employment of a preliminary colostomy involving the ascending loop followed by disconnection of the fistula, with restoration of normal continuity, or preferably subtotal gastric resection was reported by Pfeiffer and Kent [14] in 1939. More recently Marshall [15] modified the Lahey-Swinton technic by using a side to side preliminary ileocolostomy, with a later removal en bloc of the involved area, terminal ileum, cecum, ascending colon and that portion of the transverse colon which lies proximal to the fistula. Jejunojejunostomy and subtotal gastric resection are also carried out as a part of the second stage procedure.

Surgical procedures used in the treatment of our patients are shown in table 6. Because of the likelihood of reactivation of the original ulcer following restoration of normal continuity, gastric resection is undoubtedly the operation of choice. When all factors are evaluated, however, this is not at times a feasible procedure. Since recurrence of ulcer provides a continuous threat when gastric resection is not done, it appeared to us that the effect of vagotomy on patients in whom resection was not performed was worthy of determination. Vagus section, consequently, was performed on 2 patients, whose case histories follow.

TABLE 6.—*Surgical Procedures Used in Treatment of Fistulas*

| Operation | No. of Cases |
|---|---|
| Excision of ulcer, with closure of stomach, jejunum and colon | 2 |
| Gastroenterostomy, with closure of jejunum and colon | 5 |
| Gastric resection, with closure of jejunum and colon | 3 |
| Colostomy—excision of ulcer, reestablishment of normal continuity | 2 |
| Colostomy—gastric resection, enterostomy, reestablishment of normal continuity of colon | 2 |

CASE 1.—Mr. P. J. B., aged 48, entered the hospital with a history of closure of a perforated duodenal ulcer in 1941. Two years later (1943), because of recurrence of symptoms, a posterior gastroenterostomy had been done. In 1944 a recurrent diarrhea was diagnosed as ulcerative colitis. This lasted only a short time.

Three years later, in 1947, severe diarrhea, epigastric pain, weakness, loss of weight—22 pounds (10 Kg.) in three months—and striking malnutrition developed.

13. Scrimger, F. A. C.: A Technique for the Management of Gastrojejunal Ulcers With or Without Gastrocolic or Jejunocolic Fistula, Ann. Surg. **104**:594-600, 1936.

14. Pfeiffer, D. B., and Kent, E. M.: Value of Preliminary Colostomy in Correction of Gastrojejunocolic Fistula, Ann. Surg. **110**:659-688, 1939.

15. Marshall, S. F.: A Plan for the Surgical Management of Gastrojejunocolic Fistula, Ann. Surg. **121**:620-638, 1945.

Roentgenograms confirmed a diagnosis of gastrojejunocolic fistula. At operation the area containing the fistula was resected, a new anterior gastroenterostomy was made and the vagus nerves were sectioned.

Follow-up studies made eighteen months later showed the patient to be normal in weight and asymptomatic. No free acid was present in the stomach, as determined by the insulin test, and roentgenograms revealed a functioning gastroenterostomy opening.

CASE 2.—Mr. S. N., aged 51, was admitted to the hospital in 1946 complaining of epigastric pain, recurrent diarrhea, nausea, weakness and loss of weight. A diagnosis of duodenal ulcer had been made in 1920, and four years later a posterior gastroenterostomy was done. Except for a period of approximately six months following operation, he had never been completely free of symptoms. He had been hospitalized for medical management in 1930 and again in 1937.

A diagnosis of gastrojejunocolic fistula was made and confirmed by roentgen study. After preliminary colostomy and two months of preoperative care the fistulous tract was resected. No evidence of ulcer could be found by careful search, and normal continuity was restored without further surgical treatment.

Eighteen months later, in 1948, the patient returned because of distress from ulcer and occult blood in the stools. He refused gastric resection but finally agreed to a vagotomy. Follow-up studies made six months after operation found him normal in weight, asymptomatic and carrying on his duties as a steel worker. Roentgenograms revealed an adequately functioning gastroenterostomy opening, and the insulin test showed no free acid present in the stomach. The patient stated he was feeling better than at any time since World War I.

Two other patients in our series are likewise of unusual interest. Subsequent to surgical removal of an initial gastrojejunocolic fistula, a second fistula of the same type developed in each. To our knowledge this complication has not previously been reported. Case histories of these patients follow:

CASE 3.—Mr. P. J., aged 40, was referred to the hospital on Jan. 8, 1927, because of persistent epigastric pain not related to meals or relieved by diet or powders. He was anemic, and occult blood was present in the stools. Fifteen years previously roentgenograms had revealed a duodenal ulcer, and in 1912, after a severe hemorrhage, posterior gastroenterostomy had been performed.

Roentgenograms showed the presence of a gastrojejunocolic fistula, and at operation a marginal ulcer and the involved area of stomach, jejunum and colon were removed. A new posterior gastroenterostomy was done.

On Nov. 5, 1928, the patient was readmitted complaining of severe abdominal pain, dizziness, weakness and dark red stools. Roentgenograms showed, for the second time, a gastrojejunocolic fistula. The patient refused surgical treatment and left the hospital. Six months later he was readmitted in a terminal condition, and autopsy confirmed the previous diagnosis of a second gastrojejunocolic fistula.

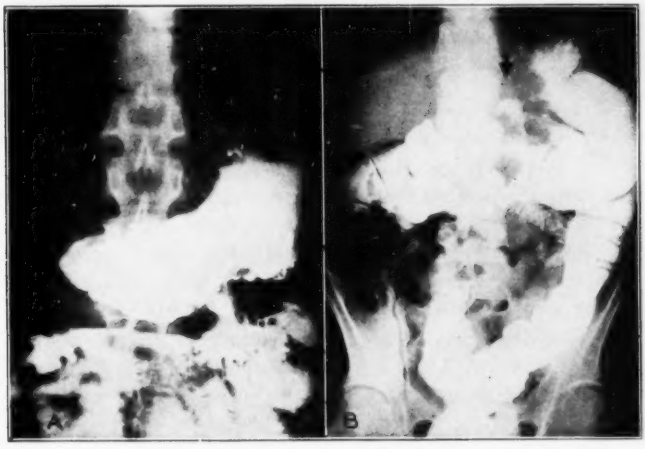
CASE 4.—Mr. J. A., aged 54, entered the hospital in 1918 with a history of epigastric distress relieved by sodium bicarbonate and food. In 1920 a diagnosis of duodenal ulcer was made, and in 1926 a posterior gastroenterostomy was done. From 1930 to 1933 intermittent attacks of epigastric distress had occurred. After these he was fairly free of symptoms for a period of four years.

Severe epigastric pain, loss of weight, nausea and vomiting forced him into the hospital in 1937, and a diagnosis of gastrojejunocolic fistula made clinically and roentgenologically (figure, *A*) was confirmed at operation. The enterostomy

opening was closed and normal continuity restored. Three years later a severe hemorrhage occurred from a recurrent ulcer, and at that time a Polya type of gastric resection was carried out.

In 1943 the patient again was admitted because of epigastric pain, loss of weight and vomiting of a soapsuds enema. Roentgenograms (figure, *B*) confirmed a diagnosis of a second gastrojejunocolic fistula. At operation the involved area was removed and an additional portion of the stomach resected. The small bowel was brought anterior to the colon for anastomosis.

Five years later, in 1948, the patient entered the hospital for the fifth time, again complaining of severe epigastric pain. He had vomited, and a large tender mass was palpable beneath the upper portion of the laporotomy scar. At operation an inflamed, thickened, distended gallbladder, adherent to the abdominal incisional scars and surrounding tissues, was found. When interviewed six months later, he was asymptomatic and feeling well.



*A*, roentgenogram taken after a barium meal showing the first fistulous tract. Rapid passage of fluid from stomach to colon and small bowel was seen by the fluoroscopic examination. *B*, roentgenogram made after a barium enema showing the second fistulous tract. Fluoroscopy revealed rapid passage of opaque fluid from the transverse colon into the stomach and small bowel.

Operative mortality from 14 operations performed during a period of twenty years was 6, or 43 per cent. However, if the patients are divided into those admitted during the first ten years of the study and those admitted during the last ten years, it is found that 5 patients died and 1 survived during the first decade while 1 died and 7 lived of the more recent group—a mortality rate of 12.5 per cent. As pointed out by Barber and Madden,[4] the dismal prognosis of past years for patients with gastrojejunocolic fistula has recently become much brighter. A summary of 21 recent collected cases, in all of which preliminary colostomy had been performed, shows a death rate of only 4.8 per cent.

Follow-up reports were obtained on 7 of our patients. One patient of the early group, in whom normal continuity was restored, was living and well two years later. In another patient, in whom resection of his marginal ulcer and replacement of the posterior gastroenterostomy opening were carried out, a second ulcer developed, which necessitated gastric resection three years later. A third patient, who underwent gastric resection in 1944, is working and without symptoms. As previously stated in their case histories, both of the patients who were subjected to vagotomy and the patient who had a recurrence of his fistula are doing well. One patient with a recurrent fistula refused surgical treatment and died soon thereafter.

## SUMMARY

1. Twenty-two cases of gastrojejunocolic fistula, which occurred as complications of posterior gastroenterostomy performed for duodenal ulcer, are reported.

2. Prominent symptoms present in all cases were uncontrollable diarrhea, loss of weight, abdominal pain, weakness and malnutrition.

3. An average of six years and two months elapsed between the original operation and the onset of symptoms of a fistula. The shortest period was eight months and the longest twenty-two years.

4. Fourteen patients were treated surgically. One stage operations were done on 10 and two stage procedures on 4. Vagotomy was effectively used on 2 patients.

5. Two cases in which a gastrojejunocolic fistula recurred after surgical removal of the initial fistula are included in this series. Development of a second gastrojejunocolic fistula subsequent to removal of a first has not to our knowledge previously been reported.

6. Operative mortality for the entire series was 43 per cent. During the last ten years this was reduced to 12.5 per cent.

## DISCUSSION

DR. ARTHUR MARKS, Maywood, Ill.: I should like to mention two reports from the literature which have been published since we started this study. The first was by Mathewson, who in 1947 apparently was the first to report the use of vagotomy in the treatment of this condition. After a first stage Lahey procedure, vagotomy was carried out through the left side of the chest. Subsequently the patient became asymptomatic and gained weight, and gastric analysis showed no free acid present. Therefore, the second stage Lahey procedure up to the present time has not been carried out.

Recently Walters, in a discussion of peptic ulcer, mentioned 4 cases of gastrojejunocolic fistula in which they had used vagotomy. Normal continuity was restored in 1 of these patients and new gastroenterostomies made in 3. This procedure has been mentioned elsewhere, and doubtless other reports of its value soon will be forthcoming.

DR. H. GLENN BELL, San Francisco: May I add 1 more case to the doctor's report of two gastrojejunocolic fistulas? In 1 of our cases the first operation was a mistake. In our state osteopaths have a right to operate. The first operation was done for duodenal ulcer. After the operation was over the patient was told by his physician: "I made a mistake. I made your anastomosis between the stomach and the transverse colon."

It was rather interesting. I saw the man three or four months after that operation and tried to convince him that he should be operated on. He was having no difficulty. You could not show the communication except by retrograde barium enema. He went along for a year and a half, perfectly comfortably and carrying on his work, and then he began having foul eructation and vomiting. He then came in.

We restored the original continuity and did a subtotal resection, and he got along well but was back in a year and a half with another gastrojejunocolic fistula. We had not connected his transverse colon to his stomach. Nevertheless, we had to reoperate and do a further resection. That was some ten years ago, and he has remained perfectly well.

DR. STANLEY E. LAWTON, Chicago: I have nothing further to add except that we observed a similar case, not in our service, in which the colon had mistakenly been anastomosed to the stomach, and subsequently a fistulous tract developed.

# PHLEGMONOUS CECITIS

## Report of Two Cases

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AND
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THE DIAGNOSIS of cecitis or typhilitis was popular until appendicitis became recognized as a pathologic entity. After this it became the general opinion that every case of inflammation of the cecal region was secondary to appendicitis and many authorities denied the existence of primary cecitis as a disease entity.

Gradually more evidence is accumulating that primary inflammation in the cecum, though rare, may occur. Two patients were treated recently who had cecitis of two distinctly different types. The first had a typical circumscribed phlegmon of the cecum characterized by a severe, submucosal inflammation and presented the picture described in the following report.

### REPORT OF CASES

CASE 1.—*History.*—A. G. was a 61 year old Polish housewife who entered the Presbyterian Hospital on Jan. 14, 1948, with the history of recurrent attacks of severe pain in the right upper abdominal quadrant following meals over a period of twenty-three years. Cholecystograms had shown a nonfunctioning gallbladder. The attacks had become so severe that she was admitted for cholecystectomy. There had been no other gastrointestinal symptoms. She had mild dyspnea and occasional substernal pain on exertion and slight orthopnea.

*Examination.*—The patient was an elderly, obese woman. Her blood pressure was 140 systolic and 94 diastolic, and the heart and lungs seemed normal. Abdominal examination showed only a moderate tenderness below the right costal margin. The hemoglobin content was 14 Gm., the red blood cell count was 4,800,000 and the white blood cell count was 5,800. The urine was normal.

*Operation.*—The abdomen was opened through a right paramedian incision. The gallbladder was thick walled and filled with stones. The appendix was delivered and found to be slightly enlarged. A firm mass 3 cm. in diameter was felt in the cecal wall near the base of the appendix. It was felt that the mass had enough of the characteristics of carcinoma to make a radical resection necessary.

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From the Surgical Department of the Presbyterian Hospital.

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 3, 1948.

After cholecystectomy a resection of 6 inches (15 cm.) of the terminal portion of the ileum, the cecum, the ascending colon and a portion of the transverse colon was performed. The ends of the bowel were closed, and a side to side anastomosis was done between the terminal portion of the ileum and the transverse colon.

*Pathologic Changes.*—There was a firm, discrete, nodular area 4 by 3 by 1 cm. in size in the wall of the cecum at the base of the appendix, partially occluding its lumen. The mucosa over this area was hemorrhagic. Microscopic sections showed an acute and chronic inflammatory process maximal in the submucosal area (fig. 1). There was some ulceration of the mucosa. Edema, fibrosis and infiltration by all types of inflammatory cells could be seen (fig. 2). Eosinophils were especially numerous. The border of the inflammatory process was sharply demarcated. Regional lymph nodes showed only fibrosis and hyperplasia.

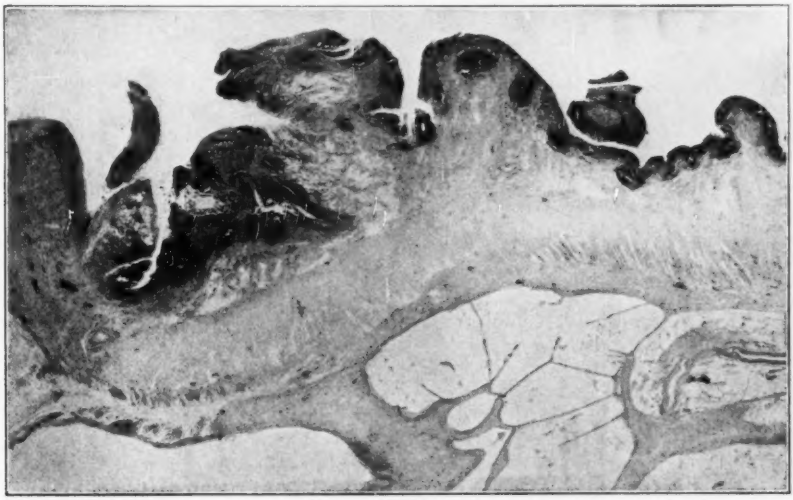

Fig. 1.—Section of the cecal wall in case 1 shows that the inflammatory process is confined mainly to the submucosa.

The gallbladder showed severe inflammatory reaction. The appendix, ileum and remainder of the colon were entirely normal.

*Postoperative Course.*—Because of the lack of preoperative preparation moderate distention and paralytic ileus developed. On the fifth postoperative day the patient suddenly became dyspneic and a rapid irregular pulse developed. Repeated electrocardiograms were suggestive of a coronary occlusion.

Under oxygen therapy and digitalization the patient gradually improved. She was discharged on the twenty-sixth postoperative day, apparently completely recovered. Several stool cultures and examinations for ova and parasites revealed no organisms.

*Comment.*—This case presents the typical pathologic picture of circumscribed phlegmonous cecitis. Reports of this condition were mainly

confined to the foreign literature until 1943, when Spivack and Busch [1] gathered 35 case reports and added 2 of their own and presented an excellent description of the disease. Since then 3 additional cases have been reported, 1 being somewhat more diffuse in character.[2]

The cause of this condition is thought to be a bacterial invasion of the submucosa either from superficial mucosal abrasions due to hard fecal masses, foreign bodies or parasite infestation or of hematogenous origin.

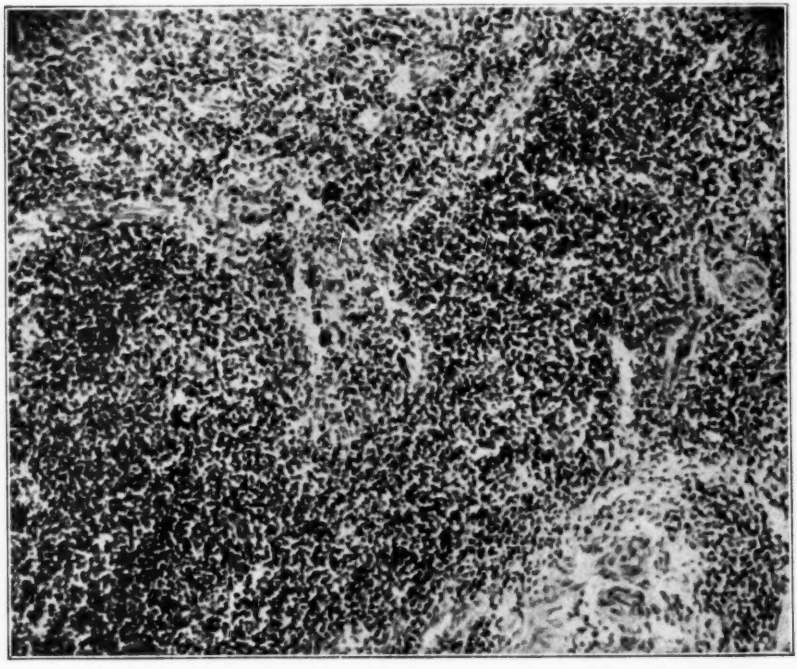

Fig. 2.—Higher magnification of the submucosal area in case 1 shows the type of inflammatory reaction.

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1. Spivack, A. H., and Busch, I.: Phlegmonous Cecitis: Report of Two Cases and Review of the Literature, Am. J. Surg. **61**:54-60 (July) 1943.

2. *(a)* Meyer, L. M., and Disch, R.: Acute Phlegmonous Cecitis, Am. J. Surg. **68**:398-400 (June) 1945. *(b)* McHardy, G., and Browne, D. C.: Phlegmonous Cecitis, New Orleans M. & S. J. **98**:532-533 (June) 1946. *(c)* Bulmer, J. W.: Phlegmonous Cecitis, M. Times, New York **75**:66-70 (March) 1947.

Pathologic Process: The pathologic process is described by Spivack and Busch as

> . . . characterized by an irregularly oval or circular area of edema and redness, sharply differentiated from the surrounding normal tissue. The area is frequently covered with thin, grayish-yellow fibrin and feels doughy. Occasionally there is central softening in the mass due to abscess formation or to ulceration of the mucosa. . . . The microscopic picture . . . consists of a profuse exudation of collagen-rich fluid in the submucosa and to a lesser extent in the subserosa. There is an infiltration of numerous polymorphonuclear leucocytes in both these areas. . . . The muscularis and mucosa are involved in the process but to a much lesser degree.

Fig. 3.—Gross specimen from case 2. The appendix is opened to show the thickened wall and adjacent cecal mass.

Diagnosis: The diagnosis is difficult. In almost all the cases in the literature the symptoms simulated those of appendicitis, with pain in the right lower abdominal quadrant, fever and vomiting. A tender mass palpable in the right lower quadrant usually leads to the diagnosis of appendical abscess. However, the presence of a mass with such a short duration of symptoms might suggest this type of cecitis rather than appendical abscess.

The clinical aspects of our case were completly atypical. There were no indications of an inflammatory process in the cecal region.

so that when the mass was discovered at operation it was much more suggestive of an early neoplasm.

Treatment: Since the condition cannot be absolutely differentiated from appendicitis or carcinoma, a laparotomy is always necessary. If the clinical picture and the gross appearance at operation are typical, two courses of treatment are possible.

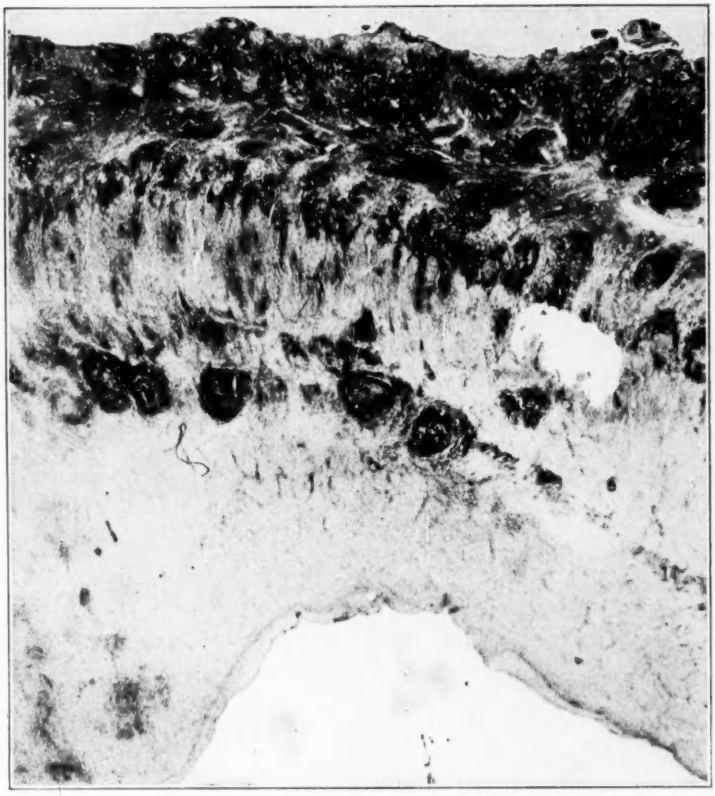

Fig. 4.—Section of the cecal wall in case 2 shows the great thickening, cellular infiltration and scattered focal granulomas.

1. The abdomen may be closed, with or without removal of the innocuous appendix. The patient is followed carefully while given chemotherapy, subsidence of the mass being observed. Fluoroscopy of the colon will demonstrate the disappearance of the cecal deformity.[3] This

3. Spivack and Busch.[1] Bulmer.[2e]

method was used in 20 cases, with 1 death due to extension and abscess formation.[2a]

2. An ileocecal resection can be done. This was performed in 10 cases without mortality. It is certainly the best procedure if the possibility of carcinoma cannot be ruled out.

In the 10 remaining cases partial resections, excision of the involved area or exteriorization was performed. There were 3 deaths in this

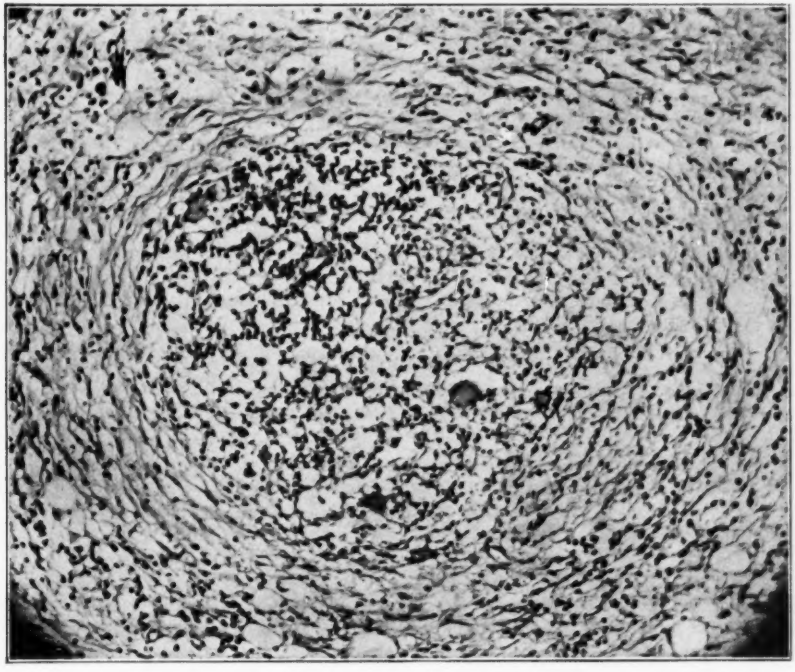

Fig. 5.—Focal granuloma from case 2 showing several giant cells.

group. It would seem that there is no middle course in the treatment of this disease.

In the second case there was a clinical picture similar to circumscribed phlegmonous cecitis but an entirely different pathologic process, most closely resembling a regional enteritis, was found, as will be discussed after the case report.

CASE 2.—*History.*—E. H., a 37 year old housewife, entered the Presbyterian Hospital on April 7, 1948, with the complaint of pain in the right lower abdominal quadrant of six weeks' duration. Six days prior to her admission the pain increased

in severity and became constant. Anorexia also developed. Previous to this she had been healthy.

Examination revealed a well nourished and well developed woman. There was a tender, movable mass in the right lower quadrant of the abdomen. The temperature was 99.6 F. The hemoglobin content was 15 Gm., the red blood cell count was 4,800,000 and the white blood cell count was 7,900. The urine was normal. The gynecologists made a tentative diagnosis of a twisted ovarian cyst.

*Operation.*—When the abdomen was opened, the appendix and the adjoining cecum were found to be enlarged into a hard nodular mass. Redness extended a few centimeters up the cecum and along the terminal portion of the ileum. There was great thickening of the mesoappendix and enlargement of the adjacent lymph nodes. Frozen sections taken from the mesentery showed "chronic inflammation."

Removal of the appendix alone would have been impossible, so an ileocecal resection was done. The ends of the colon and ileum were closed, and a side to side anastomosis was performed.

*Pathologic Changes.*—The appendix and cecum were matted into a hard, irregular mass measuring 5 by 7 by 4 cm. (fig. 3). Their walls were greatly thickened. The cecal mucosa was reddened and thrown up into hypertrophied rugae. Microscopic sections showed ulceration of the mucosa over the involved area. Edema, fibrosis and infiltration with plasma and lymphoid cells extended throughout the muscularis, serosa and mesentery (fig. 4). Scattered through these areas and in the regional lymph nodes were numerous tubercles composed of collections of large epithelioid cells and occasional giant cells (fig. 5). There was little evidence of caseation and no calcification. Sections stained by the Gram, Giemsa and acid-fast methods were carefully searched for organisms. No definite tubercle bacillus could be found. The ileum showed little inflammation.

The diagnosis of regional enteritis involving the cecum and extending into the appendix was thought to be the most probable, although tuberculosis could not be entirely ruled out.

*Postoperative Course.*—The patient made an excellent recovery and was discharged from the hospital on the thirteenth postoperative day. Her health has remained good. Roentgenograms of her chest and abdomen and intravenous pyelograms were normal.

*Comment.*—The disease in this case, though clinically simulating circumscribed cecitis, pathologically can be seen to be a distinctly different entity. The diffuse, hyperplastic involvement of the intestine with focal granulomas and giant cells suggests tuberculosis; however, certain features point to a more probable diagnosis of regional or "cicatrizing" enteritis.

Warren and Sommers [4] recently reported 120 cases of regional enteritis and emphasized that the more chronic forms of this condition are frequently mistaken for "hyperplastic" tuberculosis. Their description of the soggy, leathery induration of the intestinal wall and the thick stiffened mesentery fits closely case 2. Microscopically the pathologic process is identical. Eighty-three per cent of their patients

4. Warren, S., and Sommers, S. C.: Cicatrizing Enteritis as a Pathological Entity, Am. J. Path. **24**:475-501 (May) 1948.

had focal granulomas, and in 43 per cent there was giant cell formation. These granulomas differ from those of tuberculous origin in that the architecture is more irregular, no tubercle bacilli can be found, there is no caseation or calcification and the giant cells vary in size and have scalloped edges.

The resection of the involved bowel will probably avoid the usual complications of regional enteritis—obstruction, abscess and fistula formation.

Other types of cecal inflammation may be mentioned. Specific infections include tuberculosis, actinomycosis, blastomycosis and amebiosis. Nonspecific infections aside from the two types presented include solitary ulcers and segmental ulcerative colitis.[5]

## SUMMARY

Two cases of cecitis are presented, each representing a different pathologic entity. In 1 case there was a typical circumscribed phlegmon which was apparently asymptomatic and resembled a carcinoma. In the other case there was a more diffuse cecitis which involved the appendix and seemed to represent a form of regional enteritis.

An ileocecal resection was done in each case, with recovery.

Appendicitis so predominates among pathologic processes in the cecal region that other inflammatory processes receive little attention. Nevertheless, phlegmons of the cecum do occur primarily, and one must be prepared to recognize and treat them.

5. Cravati, C. M.: Cecal Granulomas, North Carolina M. J. **7**:633-636 (Dec.) 1946.

# HIDDEN CARCINOMA OF THE BREAST

HOWARD D. COGSWELL, M.D.
TUCSON, ARIZ.

JACKSON [1] has recently reported 3 cases of carcinoma of the breast in which the physical examination of the breast did not reveal the condition. In each case the complaint on the patient's admission to the hospital was the presence of an enlarged axillary lymph node. A biopsy of the nodes revealed carcinomatosis and was followed by a radical mastectomy. In his first case the mastectomy was not performed until the cancer had become apparent three years and four months after the excision of the axillary node. In the other 2 cases the biopsy was followed in a short time by mastectomy, and small primary carcinomatous lesions were found in both instances.

Jackson stated: "If similar incidences have been previously observed and recorded, a cursory review of the voluminous literature on carcinoma of the breast failed to reveal it." The dearth of such reported cases is possibly indicative of the rarity of the condition, but it may be that reports of such cases have been neglected in the literature and that they are not so rare as seems apparent.

Of late, a similar case has been observed and forms the basis for this report.

## REPORT OF A CASE

A woman aged 45 entered the hospital on March 29, 1948, complaining of a mass in her left axilla. About six weeks previous to her admission she had been disturbed by pain radiating down her left arm roughly following the sensory distribution of the radial nerve. Examination by her physician revealed an enlarged node in the left axilla. The patient had recently recovered from what was thought to have been a virus infection of the respiratory tract. The adenopathy was thought possibly to be associated with this infection. In about ten days the neuritis had improved, and the patient believed that the node had diminished in size. Four days before admission the gland suddenly enlarged to the size of a small tangerine and the neuritis reappeared with more intensity than had previously been present. Physical examination showed the node to be tender, hard and not attached to the skin, but it was not freely movable. Careful examination of the

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Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 3, 1948.

1. Jackson, A. S.: Carcinoma of the Breast in the Absence of Clinical Breast Findings, Ann. Surg. **127**:177 (Jan.) 1948.

left breast gave no evidence of tumor or abnormalities. No other demonstrable enlargements of lymph nodes were found elsewhere. Roentgenograms of the chest were normal. The blood count and urine were normal. The serologic test gave a negative reaction.

On March 30, 1948, the node in the left axilla was removed, and it was reported that the frozen section did not reveal any malignant process. Fixed sections, however, showed the architecture of the lymph node destroyed to a large extent by tumor tissue, and the diagnosis of metastatic adenocarcinoma was made. The frozen section had evidently been cut through a necrotic, hemorrhagic section masking the true nature of the tumor (figs. 1 and 2).

Radical excision of the left breast was done on April 5, 1948. The pathologic study of the breast was made by Dr. Louis Hirsch. His report was as follows:

Fig. 1.—Biopsied lymph node showing large central area of necrosis. Gross specimen measured over 2.5 cm. in length.

*Gross Changes.*—Specimen consists of breast, adjacent muscle and lymphatic tissue. The nipple is not inverted or fixed. There is a small nodule which is situated at the lower border of the breast 7 cm. below the nipple. It measures 9 mm. in diameter (fig. 3). It is stony hard and coarse. The breast tissue elsewhere is coarse, and there appear to be multiple papillomas. These take the form of tiny excrescences which are noted when the breast is incised. There is a small amount of intervening adipose tissue which is lobulated and lipomatous in appearance. Examination of the axillary fat reveals many large lymph nodes, the largest of these measuring 2.5 cm. in diameter. Cut sections show these to be composed, to a large extent, of a yellow caseous material. There is little nodal architecture left.

*Microscopic Changes.*—(*a*) Breast (section through tumor): The architecture is disrupted by neoplastic overgrowth of cells. Most of the glands are well formed. There are a few areas which appear definitely malignant; for the most part, however, the section resembles sclerosing adenomatosis (fig. 4). (*b*) Lymph Nodes:

There are some well formed glands. However, many of the glands show central areas of necrosis. These are bordered by a thick layer of phagocytes, and near the periphery malignant cells are seen.

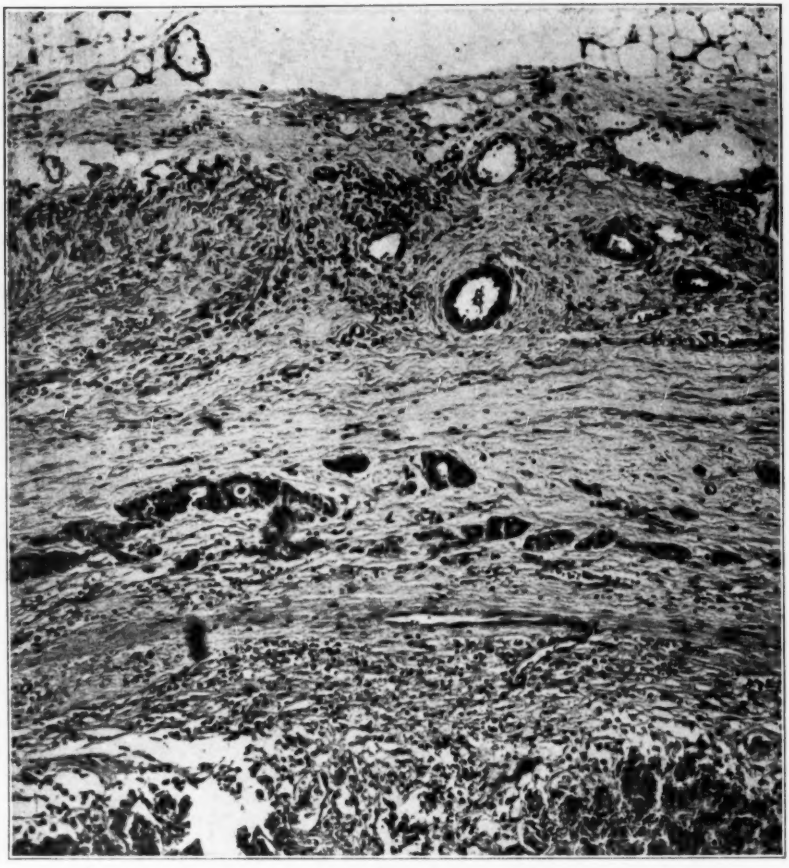

Fig. 2.—Photomicrograph of biopsied node illustrating the thin rim of metastatic tumor cells and their relationship to necrosis.

*Pathologic Diagnosis.*—The diagnosis was (1) adenocarcinoma of the breast and (2) metastatic adenocarcinoma of regional nodes.

*Postoperative Course.*—The patient's postoperative course was complicated by phlebitis of the left brachial vein. The rapid subsidence of pain and edema in the arm following stellate ganglion blocks with procaine hydrochloride was in

accordance with the experience of Hanelin and his co-workers.[2] She was discharged from the hospital on April 14, 1948. Since this date she has had irradiation and has regained her preoperative weight.

The axillary lymph glands are divided into five groups and vary from twenty to thirty in number. The afferent lymph vessels of these glands drain the arm, the skin and muscles of the anterolateral wall of the body above the level of the umbilicus, the skin and muscles of the

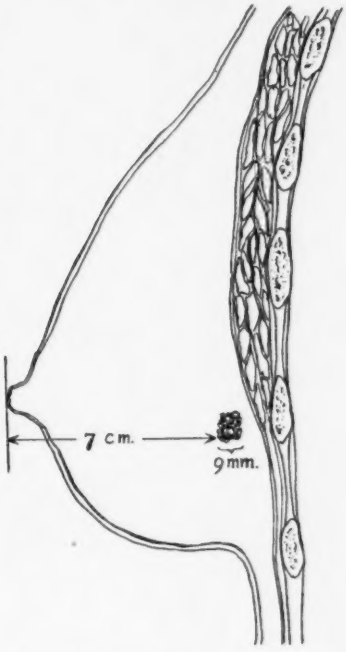


Fig. 3.—Relative size and relationship of tumor to nipple.

dorsal aspect of the trunk, the lower portion of the back of the neck and the central and lateral parts of the mammary gland. It is difficult to understand how metastasis to axillary lymph glands could occur from a primary tumor elsewhere than from the regions drained by the afferent lymph channels. It has occurred, however, and Jackson [3] has recently

2. Hanelin, H. A.; Williams, J. M.; Wolfeson, S. M., and Wernick, E. D.: Treatment of Postoperative Swelling of the Arm Following Mastectomy. Arch. Surg. **55**:723 (Dec.) 1947.

3. Jackson, A. S.: Personal communication to the author.

observed a case of metastasis to axillary lymph glands secondary to carcinoma of the liver. It is with some trepidation that, on the basis of biopsy of a lymph node, the recommendation of radical mastectomy is made to the patient after careful examination of the breast reveals no

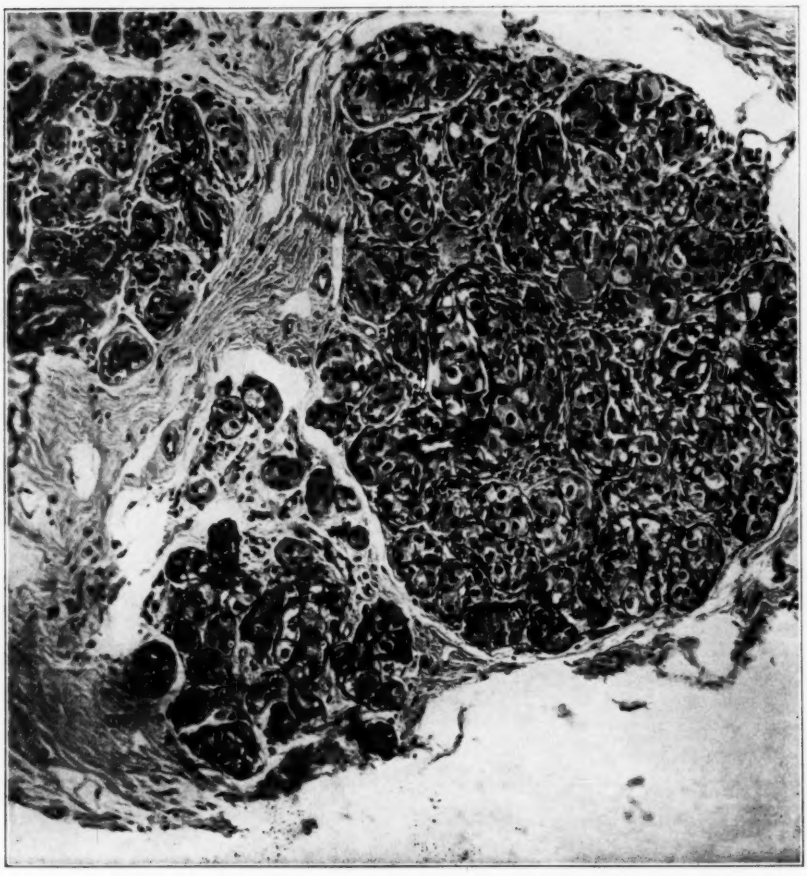

Fig. 4.—Photomicrograph of the breast lesion showing the primary carcinomatous lesion. Grossly this primary site measured 9 cm.

evidence of a tumor. If no other primary site can be determined, however, the operation should be recommended as this interesting and possibly rare type of carcinoma of the breast seems to be similar in its behavior to the papillary adenocarcinoma of the thyroid gland. These

malignant growths of the thyroid are discovered by the presence of "aberrant" tumors in the neck which are secondary to a small, often hidden, primary tumor of the thyroid gland, which acts as a feeder for the spread of malignant cells to the adjacent lymph nodes.

The 3 cases reviewed by Jackson and the report included here emphasize the importance of a thorough palpation of the axillas in examinations of women. "If axillary nodes are found, they should be removed for pathologic examination, and, if found to be malignant, the advisability of a radical breast amputation should be given the most serious consideration." [1]

## DISCUSSION

Dr. Arnold S. Jackson, Madison, Wis.: When one removes an axillary gland and has a report from a pathologist of adenocarcinoma and when observers report the breast normal, it takes a great deal of courage to remove that breast. Three years ago I did not have that courage. The first patient was a sister of an excellent internist, and the pathologist reported that it was either an axillary sweat gland tumor, which Dr. Speed has talked to us about in the past, or a metastatic lesion possibly from the breast.

We decided to observe this patient at three month intervals, which we did for three years and four months, and we finally noted a small lesion in the breast and performed a radical mastectomy. She is still living and apparently is getting along all right.

After the publication of this paper I began to receive communications from men in various parts of the country who had recently observed a similar case, and Dr. Blackburn, who is here from Guys Hospital, told me this afternoon that he has just had a case of this nature. I am sure that all members of this Society have either had a case or will encounter one.

Now I must give you a word of caution. When the second patient came along, and at least twelve men had examined the breast and pronounced it normal, I said to the woman, "If you were my wife, I would remove that breast." We did remove it, and on turning it over we noted a lesion about the size of the head of a match, which proved to be the primary source of the carcinoma.

Not long ago a woman about 48 years of age, on whom I had done an operation on the thyroid for Hashimoto's disease six months before, came back complaining of a painful node outside the breast near the sternum. Foolishly, I paid no attention to it at first because the woman was in the menopause and was a little neurotic. Some weeks later I removed it, and it was pronounced metastatic carcinoma. Shortly thereafter enlargement of axillary glands developed; I removed the glands, and they were pronounced carcinomatous.

I then consulted the man who I believe is the top pathologist of the country. We talked it over, and I said, "Do you think this could have been from the thyroid? Was it a malignant process instead of Hashimoto's disease?" He made a careful study and said no.

In view of the other 2 cases we then decided that in justice to the woman we should remove the breast. We did a simple mastectomy, and the breast was pronounced normal. Six months later the woman died, apparently of carcinoma primary in the liver. At no time were there clinical signs of carcinoma of the liver. There was no jaundice.

Dr. Harry B. Zimmermann, St. Paul: Apropos of Dr. Cogswell's paper, I had an interesting experience not long ago. A 53 year old woman was

referred to me because she had a serous discharge from one nipple. Physical examination of the breast showed it to be entirely normal—both breasts were exactly the same, with no evidences of tumor or induration.

Because I had recently acquired the fixing solution for the Papanicolaou technic, I made a smear from the nipple secretion and received a report from the pathologist that the smear showed definite cancer cells. After consultation with the pathologist it was decided to remove the breast. This was done; serial sections were made through it and an area found that might have been interpreted as a cancerous infiltration, although no palpable tumor was present. On histologic study this area proved to be cancer. A radical operation was done, and in the axillary contents several metastatic nodes were found.

This was such a spectacular experience that I shall continue using the Papanicolaou technic in similar cases.

Dr. Herbert H. Davis, Omaha: I am much interested in this paper, especially so because of a similar case that I have encountered. Mrs. M. O. S., aged 75, came to me on Nov. 16, 1943, because of a lump in the right axilla which she had first noticed in April. She stated that it had not changed in size and that there was slight soreness in it. She had lost 13 pounds (5.9 Kg.), her weight decreasing from 125 to 112 pounds (56.7 to 50.8 Kg.) in that six months. Examination revealed a subcutaneous nodule approximately 1.5 cm. in diameter in the central portion of the right axilla. It was well encapsulated and freely movable. Her breasts were rather small. I examined them both carefully and absolutely no tumor was palpable. I advised excision and biopsy of the axillary lump. One week later I excised this lymph node. It was firm, perfectly encapsulated and easily enucleated. No other enlarged lymph nodes were found. Dr. Charles Baker's pathologic report stated: "Grossly the node is enlarged (2 by 2 by 1 cm.) and is firm. Sections showed scattered through the node highly malignant carcinoma cells. There is practically no differentiation. The cells are large and have large nuclei, and there are many mitotic figures. In my opinion, however, this is most likely an adenocarcinoma, and the breast is the most likely site of the primary tumor. The diagnosis is grade 4 adenocarcinoma in lymph node."

The patient wished to go south for the winter, so I referred her to the Ochsner Clinic for more study hoping that the primary carcinoma would be found. The physicians saw her several times and also were unable to find any primary growth. They gave her a course of high voltage roentgen ray therapy to the right axilla and to a chain of slightly enlarged lymph nodes in the left side of the neck. She was also studied that winter by Dr. George W. Owen and Dr. W. R. Bethea, both of Jackson, Miss. They found a firm mass just posterior to the left tonsil and in the nasopharynx. They thought that this might be the primary growth and gave roentgen ray therapy to this area. No biopsy was made from it, however. Nothing abnormal was made out in the breast either at the Ochsner Clinic or at Jackson, Miss.

Early in July 1944, which was nine months after I had done the biopsy of the axillary node and sixteen months after she had first discovered the enlarged axillary node, she noticed a small lump in the right breast. On examination I noted that her breasts were extremely small and atrophic. In the peripheral zone of the right breast laterally at the level of the nipple was an extremely small, freely movable lump 8 mm. in diameter, which was well encapsulated and not adherent to the skin or fascia. I removed this for biopsy, and Dr. Baker, on immediate frozen section, pronounced it grade 4 carcinoma. Therefore, I performed radical excision of the right breast. In so doing, I found two small

central axillary nodes, each about 6 or 7 mm. in diameter. They were about 2 cm. inferior to the axillary vein. Microscopically, these nodes were replaced by grade 4 adenocarcinoma.

A month later at home she had a rather serious heart attack. However, she survived that and several less serious ones since. At the present time she is still living, at the age of 80, and I understand she is in surprisingly good health.

Regarding Dr. Zimmermann's remarks, eight or ten years ago a woman in her sixties appeared with a complaint of recent watery discharge from the left nipple. I palpated carefully and could find no lumps. At her age it was unusual to have that sort of thing. It was not bloody. I started checking. In Cheatle and Cutler's book there is a page devoted to this, in which they reported on a similar patient. They did not think that the discharge meant anything but much to their chagrin the woman died of carcinoma of the breast. They had 3 other patients with similar findings, and 2 of them turned out to have carcinomas.

I quoted this to my patient and did a simple mastectomy because we did not know where to look for biopsy material. In the section we found carcinoma, so we did a radical mastectomy.

Dr. W. H. Gatch, Indianapolis: I should like to state what I think is the proper way to examine a breast for cancer. If you slice it at random, as is often done, you will miss these small cancers. We have found the following method effective. Fix the specimen in formaldehyde, then slice it with an ordinary meat slicer, in slices not more than ⅛ inch (0.32 cm.) thick. Put each of these on a board and examine with a magnifying glass under good light. Make sections of every suspicious piece.

I have been especially interested in that technic in the examination of breasts removed because of a bloody discharge from the nipple. We have discovered in this way some extremely small cancers.

I have seen cases like that reported by Dr. Cogswell. I was once called to a hospital to see a woman who was paralyzed from the shoulders down. Roentgenograms showed that her spine was riddled with metastasis. Her breasts were small, flat and entirely free of lumps. I got, finally, a history that she had had a small tumor of the breast a year before, treated with roentgen rays. I presume it was one of the 12 per cent which are radiosensitive.

What Dr. Cogswell has told us about cancer of the breast can occur in cancer almost anywhere. I recently had this hair-raising experience. A man came to me with the complaint of gallstones. He had had a couple of attacks. He did have gallstones, and we took out his gallbladder; I happened to feel along the top of the liver, and there I discovered a dimple. I thought I could feel something deep under it. Fortunately I cut down through the liver for about half an inch (1.27 cm.) and took out a little nodule, which proved to be cancerous. I then searched everywhere inside the abdomen but could not find a sign of tumor anywhere. In four months that man was dead of abdominal carcinomatosis.

With all the rumpus that is being raised about cancer, one subject has been singularly neglected, and that is a study of the natural history of cancer. What happens to cancer when it is not treated at all? One recent report on the progress of cancer control stated that on the average a patient with cancer of the breast dies two years after the appearance of the tumor. I believe that this is utterly false. I have under observation a woman who has a cancer of the breast which appeared twenty-five years ago. A fungating mass of cancer as big as her head replaces her right breast. The right side of her chest is entirely filled by cancer. Despite all this she is still in a fairly good state of health.

To evaluate the results of treatment of cancer we need a thoroughgoing scientific study of what happens to cancer when it is untreated.

DR. GUY BLACKBURN, London, England: My prime purpose in rising to transgress on your time is to thank you for the hospitality you have kindly extended to me through my friend Warren Cole and for the perfectly wonderful time I am having here. I think the reason that this so-called hidden carcinoma of the breast has not been well reported in the literature is a relatively simple one, and one does not have to look far to appreciate it. The reason (and I speak from experience of a case that Dr. Jackson referred to) is that the surgeon is apologetic to the patient and to himself for having made this error. He likes to conceal it, and he may confess it to one of his surgical colleagues over the English equivalent of a highball.

The patient that I saw should have been operated on and would have been operated on a month before she was had I appreciated this fact and had I realized what I think should like to teach students now, namely, that a metastatic axillary gland should be considered a metastasis from a primary carcinoma of the breast until one has removed the breast and proved that it contains no carcinoma.

I should like to record a similar case in which operation had been performed by one of my senior colleagues, who confessed to me in the later hours of the evening, after an excellent dinner (and we have those occasionally, you know). He told me of a woman of some 60 years of age who had such an axillary gland, and who was, may I say, old fashioned. He removed the axillary gland. The pathologic report came back reading, "squamous cell carcinoma." He advised her to have a radical amputation of the breast. She declined politely for successive visits over two or three years, and for the past ten years he has received twice a year, ever since the beginning of the war, a package in the post containing a dozen eggs. I need hardly remind you that those are not subject to income tax.

DR. E. P. COLEMAN, Canton, Ill.: I should like to report 2 cases because of the unusual location of metastasis. Twenty years ago I saw a woman, then 55 years of age, who had attended a talk on cancer of the breast. She came away much impressed and saw me shortly thereafter, feeling sure she had cancer of the right breast. She was emaciated and nervous and had atrophic breasts. She had almost no mammary tissue at all. The thing she was most concerned about was a lipoma, smaller than a pigeon's egg in size, in front of the right mammary gland, which she had had for ten or twelve years. It had never bothered her, but she had heard that talk and had become conscious of it.

I thought I would reassure her, because she was unduly alarmed. I examined the breasts carefully and found nothing. As a matter of fact, there was very little to examine. She was reassured and went away. The next week she came back. Was I sure it was not cancer? I was. She returned the next week. She did that for six or seven weeks. Finally I said to her, "We will remove that tumor tomorrow, not so much to get rid of it but to get rid of your apprehension."

I took it out the following day; it was a small, normal-appearing lipoma, a thing we called normal, but in the center of it was a small nodule about the size of a grain of wheat. The pathologist reported it adenocarcinoma.

As an Irish friend once remarked, "I had to eat my words." A radical removal of the breast was done, and just back of the nipple was a small nodule about the size of a pea, which was the primary cancer. The woman has had no recurrence and is still living. I have since removed part of the colon for a cancer of

the sigmoid, and she is just now out of the hospital after having had a resection for cancer of the stomach. There is no connection between the three, microscopically.

The second case involved a woman six and a half years ago, aged about 50 at that time, who had a lump in her neck just below the ear. It was apparently a lymph gland, hard but movable. I removed it, and it was reported as being adenocarcinoma. The pathologist said it was probably primary in the breast.

This woman was rather obese. I examined the breasts carefully on several occasions but could find nothing. Finally, looking her over, I noticed that the right nipple was somewhat irregular, almost wartlike in appearance, and was informed that it had always been that way. I removed it just to see what it was, and there was apparently the primary growth. It, too, was adenocarcinoma, of the same type, apparently, as was the gland in the neck. Because this had gone through the lymphatic vessels to the top of the neck, it seemed futile to do a radical mastectomy. She was given roentgen ray treatment; no further operation was done, and she has had no recurrence to date. It will come some time, I am sure; when, I do not know.

DR. WARREN H. COLE, Chicago: Before we close the discussion I should like to call on Dr. Powell. He is too bashful to come up voluntarily to close this discussion.

DR. CUTHBERT POWELL, Denver: I want to report a similar case of a woman aged 63 who came to our office in September 1946 complaining of a small nodule in the right axilla. She was seen by one of my associates, who asked me to examine her. The nodule was freely movable, not adherent anywhere. Absolutely nothing could be found in the breast. However, I advised removal of the nodule. It was reported as carcinoma. The breast was removed, and a carcinoma was found. There has been no evidence of any trouble since then, and that was more than two years ago, so far as the breast is concerned.

She came in on July 20 of this year with an ulcerated area in the right labia minora, which proved to be a squamous cell carcinoma, and vulvectomy was done. This woman had a sister with a carcinoma of the breast which was removed by me two years ago.

DR. H. D. COGSWELL, Tucson, Ariz.: I want to thank the discussers. I believe the credit for this recognition goes to Dr. Jackson. His article came out last January, emphasizing this hidden tumor.

# EFFECTS ON THE BREAST OF REMOVAL OF THE NIPPLE OR SEVERING OF THE DUCTS

HERBERT H. DAVIS, M.D.
OMAHA

IS IT dangerous to remove a nipple and leave the glandular tissue of the breast without any duct opening to the exterior for drainage of secretions? What will happen if pregnancy and lactation occur later? Will stasis in the ducts and acini produce chronic inflammation, cysts or cancer? Obstruction of the lactiferous ducts in the nipple produced by tying them off or burning them has been used in mice and rats to produce carcinoma experimentally. On the other hand, most textbooks, in discussing lesions of the nipple, advise simple removal of that structure, but none of them state whether there is any danger regarding inflammation, galactocele or carcinoma developing later in the breast.

## EXPERIMENTS ON ANIMALS

An evaluation of the effect of one type of chronic irritation—milk stagnation—on the incidence of mammary carcinoma has been attempted experimentally in mice. Bagg [1] ligated the mammary ducts on one side in pregnant animals of a strain in which carcinoma of the breast normally developed in about 5 per cent. On the side ligated marked stasis of the mammary ducts developed, with a considerable amount of decomposed, stagnated and probably chemically altered milk, which was sufficiently irritating to cause considerable disturbance within the breast. Only a small number of operations were done, but tumors developed in the breast in which the ducts had been ligated in 2 of the first animals operated on.

Bogen [2] similarly ligated the mammary ducts of 18 female mice, in 6 of which mammary cancer developed, while 18 normal breeding controls died without tumors.

Fekete and Green [3] felt that these investigations were inconclusive because of the small number of animals in each, the possible operative

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1. Bagg, H. J.: The Functional Activity of the Breast in Relation to Mammary Carcinoma in Mice, Proc. Soc. Exper. Biol. & Med. **22**:419-421, 1925.

2. Bogen, E.: The Cause of Breast Cancer, Am. J. Pub. Health **25**:245-250 (March) 1935.

3. Fekete, E., and Green, C. V.: The Influence of Complete Blockage of the Nipple on the Incidence and Location of Spontaneous Mammary Tumors in Mice, Am. J. Cancer **27**:513-515 (July) 1936.

injury to mature glands and the low normal incidence of tumor together with the unknown genetic constitution of the mice in Bogen's experiments, which made an adequate control difficult. They first used a strain of mice in which carcinoma of the breast develops in over 80 per cent of the females with a normal reproductive history. At 10 days of age, while the mammary glands were in an undeveloped condition, the five nipples on the right side were touched with a fine red-hot wire to seal them permanently without affecting the development of the glands. At the age of about a month, the females were allowed to breed normally. Of the 49 female mice so treated, mammary gland carcinoma developed in 40, which was about the normal rate for that strain. The tumors were on the occluded side only in 22, or 55 per cent, while in but 3, or 7.5 per cent, the tumor developed on the untreated side only. In the remaining 15, or 37.5 per cent, carcinoma appeared on both sides.

They then tested whether stagnation itself can overcome a hereditary influence unfavorable to the formation of tumors. They did similar experiments in a strain in which mammary cancer normally appeared in far less than 1 per cent of the breeding females. Of these 43 mice, in not 1 was a tumor observed.

Bagg and Hagopian [4] reported that rapid breeding and prevention of suckling resulted in cancer of the breast in 4 of 29 rats, or 14 per cent.

The investigations of Bagg, Bogen, Fekete and Green and of Bagg and Hagopian have shown that in mice and rats the presence of stasis due to retention of secretions within the ducts as a result of nonsuckling of the young is a prominent feature in causing the development of mammary carcinoma. In addition to the presence of internal factors of a hormonal nature, it is probable that the chemical irritation of retained mammary gland secretions may bear a causative relation to tumors of the mammary gland in female mice and rats.

## CLINICAL EXPERIENCES

Adair and Bagg [5] and later Adair [6] made a clinical study of the relation between stasis of the secretions of the female breast and the development of mammary carcinoma. Adair analyzed a series of 200 consecutive cases of women suffering from carcinoma of the breast.

4. Bagg, H. J., and Hagopian, F.: The Functional Activity of the Mammary Gland of the Rat in Relation to Mammary Carcinoma, Am. J. Cancer **35**:175-187 (Feb.) 1939.

5. Adair, F. E., and Bagg, H. J.: Breast Stasis as the Cause of Mammary Cancer, Internat. Clin. **4**:19-26 (Dec.) 1925.

6. Adair, F. E.: Etiological Factors of Mammary Cancer in Two Hundred Women, New York State J. Med. **34**:61-68 (Jan. 15) 1934.

In 74 of these the normal breast function had never been established. He cited 1 of these who had undergone five operations on the breast. The first operation occurred at 16 years of age, when a fibrous tumor the size of a hen's egg was removed. The patient was later operated on at the ages of 30, 33 and again at 40 years, at which time she was found to have a carcinoma. Adair felt that numerous surgical injuries produced damage to the duct, fibrosis and stagnation peripheral to the scar. One hundred and twenty-six of the patients had borne children. Of these, only 17 gave an absolutely normal nursing history. One of these patients bore 19 children, including three pairs of twins. All were fed from a bottle. The first child was born when the mother was but 16 years of age. By the time she was 44 years old, her mammary cancer was well developed. Adair felt that stagnation of milk played an extremely important part. In this group of patients a large volume of milk was found within the mammary system. Millions of newly formed lining cells eventually desquamated to lie free within the lumen and underwent disintegration and became a source of chemical irritation.

The 126 mothers bore 386 children and had 172 miscarriages. Adair was of the opinion that miscarriage or abortion was exactly the same as a pregnancy as far as the breast was concerned, as it causes hypertrophy and the production of milk. This proportion of miscarriages is much higher than usual, as shown by other authors who have studied the frequency of miscarriage.

Adair studied 100 control patients in whom carcinoma did not develop and was struck by the complete lack of unusual incidence relating to the nursing history and of such conditions as abscess formation, inverted nipple, caked breasts and miscarriage. Of these patients, 78 had borne children, and there were only 18 miscarriages or abortions, which is about the usual figure.

Adair discussed conditions which can cause stagnation in the breast. It may be due, as stated before, to improper nursing, to stopping it too soon, to frequent pregnancies or to miscarriage or abortion. Not associated with pregnancy, the ducts may be obstructed by localized outgrowth of the lining epithelium or by a change in the nipple, such as inversion, valve condition, flat nipple or ulcerated nipple. There may be a fibrous scar across the duct resulting from an incision for abscess or a contracted scar secondary to a traumatic hematoma. A cyst may cause obstruction. A plug of desquamated lining cells may cause obstruction of the nipple, resulting in inflammatory reaction. Adair concluded that his clinical study corroborated the experimental evidence in animals that stagnation in the mammary ducts seemed to increase the incidence of carcinoma of the breast.

A pertinent article appeared recently by Tice, Dockerty and Harrington [7] on comedomastitis, a disease of the breast characterized by dilatation of the lactiferous ducts, which are distended with inspissated grumous material that may be expressed when the duct is cut, much as comedos are expressed from ordinary blackheads. It is a disease of the large ducts, about which are aggregates of wandering cells, lymphocytes and plasma cells. This was a study of the cases at the Mayo Clinic in the years 1925 to 1942, 185 patients being treated by local mastectomy and 19 by local mammary resection. The nipple was found to be abnormal in 31 of these, with retraction or inversion in 28 and inflammation in 3. In 1 the nipple had been surgically removed previously. Abnormalities of lactation were noted in 10.4 per cent of the breasts, and in more than half of these advanced disease was noted. It was found that 23 of the breasts contained concurrent papilloma and 18 contained carcinoma. Breasts which contained cysts or apocrine epithelium or both formed a large majority of the cancerous group. The possibility that most carcinomas associated with comedomastitis arise from the ductal system as comedocarcinoma was suggested by the finding of comedocarcinoma in 5 cases and comedo areas in 5 of the infiltrating growths. The authors concluded that comedomastitis usually is associated with chronic cystic mastitis, which may overshadow it clinically, and also that plasma cell mastitis is probably a form of comedomastitis. They felt that neoplasia, although occasionally occurring in the same breast, is probably not related to comedomastitis etiologically. However, by simple obstruction of the mammary ducts, such neoplastic changes may at times produce comedomastitis.

The following case is the basis for this article:

Mrs. G. C. A. was first seen by me in 1932 at the age of 23. She had had a milky secretion from the left nipple and a raw area on or around the nipple since the age of 6 or 7. On examination, a weeping reddened surface covered practically the entire nipple, which was about four times the normal size. There was no induration. The breasts were small, and there were no lumps felt beneath the nipples or in any part. Sir Lenthal Cheatle saw the patient with me. He advised excision of the nipple even though he or none of us had been able to make a diagnosis. In 1933 I did a local resection of the left nipple. After this she had no disturbance in the breast. Since then she has had two children, a daughter born in 1936 and a son in 1942. During the pregnancies there were no differences noted between the two breasts. At lactation both breasts enlarged normally. She tried to nurse from the right breast, but it had an inverted nipple so she could not. The right breast was pumped twice a day for a week. Both dried up equally in two weeks. She used camphorated oil on them. I last saw her on Nov. 10, 1948, fifteen years after the thelectomy, when she was 39 years of age. For the previous two weeks she had been complaining of occasional slight shooting pain in the outer part of

7. Tice, G. I.; Dockerty, M. B., and Harrington, S. W.: Comedomastitis, Surg., Gynec. & Obst. **87**:525-540 (Nov.) 1948.

the right breast, which was not the one operated on. On physical examination both breasts were rather small but exactly the same size and consistency. Nothing abnormal was felt in either one. There were no lumps, no increased nodularity and no tenderness. In the left breast was a transverse scar replacing the nipple.

This patient, in the fifteen years following thelectomy, has noticed no abnormal changes in the breast in which there is no connection of the ducts to the exterior.

In the excision of benign tumors and cysts from central and intermediate zones of the breasts, the mammary ducts are not infrequently severed or excised. This may happen even when the mass is several centimeters from the nipple if, in the procedure, the mass is pulled on so that it draws the tissue from beneath the nipple into the wound. I, therefore, have made a study of 30 cases of cysts and benign tumors centrally located in which I am sure I cut these ducts in the removal of the mass. Those in which the ducts beneath the nipple were not cut across are not included. The patients were operated on between 1931 and 1946. They varied in age from 28 to 68. In 20 the right breast and in 10 the left breast was involved. Of these, 25 have been heard from within the last month. One has died of unrelated causes. Of the remaining 24, 22 have had no trouble with the breast operated on. One of these, operated on in 1936, at the age of 31, has had three children since. In 1947, after weaning her youngest baby, a small galactocele developed in the opposite breast. The involved breast caused no trouble.

Of the other 2, 1 has had three children since operation and nursed them without trouble, but she wrote that she has had a small lump for three years in the breast operated on, which is not enlarging. The other woman, operated on three years ago at the age of 41, has had some pain in the breast. She thought that a lump appeared, but it disappeared again.

In none of these patients has carcinoma developed. However, this does not prove that it might not occur in the future. This series is too small and far too short a period is involved to be conclusive.

Except for 1 case reported by Tice, Dockerty and Harrington,[7] I have never been able to find any clinical reports of carcinoma of the breast arising after excision of the nipple or severing or excision of the mammary ducts beneath the nipple in the removal of a centrally located benign tumor or cyst. In the performance of mammoplasty for hypertrophied or pendulous breasts the blocking of ducts must be frequent. Some surgeons, such as Max Thorek, remove the nipple and areola and place them in a higher area as free grafts in this procedure. The mammary ducts remaining have no communication with the surface. There are no reports of carcinoma following these mammoplasties.

## CONCLUSIONS

Experiments on mice and rats give the impression that ligation or closing of the nipple by cautery may cause the development of carcinoma in the underlying breast. However, many of these experiments were on strains in which the incidence of cancer is high.

There is evidence in the literature that obstruction at the nipple in human beings may cause stagnation, chronic inflammation and comedomastitis. Definite proof that carcinoma may result is lacking.

A patient is reported on who in fifteen years following thelectomy has had two children and has had no trouble whatsoever with the breast.

A follow-up study was made on 24 patients in whom the ducts beneath the nipple were excised in the removal of benign tumors or cysts. In none of them has carcinoma developed.

No definite conclusions can be made as to the danger of removal of the nipple or severing of the mammary ducts in human beings. The question has never been answered satisfactorily, and it is hoped that this discussion will lead to interest in the problem.

## DISCUSSION

Dr. Erwin R. Schmidt, Madison, Wis.: Thelectomy may seem to be a trivial matter. The case described in the paper was discussed with the author fifteen years ago when I visited him. The results of such a procedure were unknown. While incisions in the breast have been done for a long time and no untoward results seen or reported, what would result from a complete excision of the nipple was indefinite. Reasoning from pathologic pictures supposed to be due to obstruction of the ducts and from various histologic pictures presented in cystic mastitis of the breast came to mind. What would happen if the patient became pregnant? Would a parenchymatous type of inflammation (caked breast) develop? It would be impossible to reduce the tension by either artificial or natural means. These were some of the questions we asked ourselves. Since then the pancreatic ducts have been ligated with little residual effect on the physiology of digestion. Therefore it seemed worth while to follow this patient for a number of years to see if some of these questions could be answered.

There are accessory breasts and breast tissue. In the upper outer quadrant of the breast, extending into the axilla, breast tissue is found which may be connected to the breast or may not. This situation often brings up the question of a malignant growth. This tissue, whether connected or not to the main breast tissue, seems to get along all right. Suggested for restriction of physiologic activity is the use of stilbestrol soon after delivery.

It is a worth while observation, for in the literature there is little about this condition, and the personal experience of my colleagues and myself is practically nil.

Dr. S. W. Harrington, Rochester, Minn.: I have been very much interested in Dr. Davis' presentation of the subsequent effects on the breast following the removal of the nipple or severing of the ducts during local excision of tumors, and I agree with his conclusions that there is no definite evidence to indicate that surgical procedures for benign lesions which require removal of the nipple or

severing of the ducts have been followed by malignant disease. I have seen cancer of the breast occur in patients who have had a plastic operation for pendulous breasts. This is a rare occurrence, and I do not believe it is due to the plastic operative procedure. I think that cancer would have developed whether or not the plastic procedure had been done, but it is unfortunate that the procedure masks the malignant process, so that the diagnosis is not established until it is well advanced.

Some years ago I followed a series of 200 patients who had been operated on for benign lesions, particularly those in whom the lesion was found to be Schimmelbusch disease, which is essentially a proliferative type of mastitis. Some pathologists consider this type of mastitis as a precancerous condition, so I made a study comparing the results obtained in patients who underwent simple mastectomy with those in patients in whom local excision was performed. I was unable to find that any patient had returned to our clinic or had been operated on elsewhere for a malignant growth of the breast.

This is an important subject which Dr. Davis has brought before us because of the necessity of removing many benign lesions in order to rule out the possibility of a malignant lesion. If there were a possibility of these local excisions being followed by a malignant disease, it would present a definite hazard. In view of the great number of patients who have had local excision of tumors performed for diagnosis, during which time the ducts must be excised in many instances, if malignant disease were to follow this procedure, it would be noted in a relatively high percentage of patients. I believe that Dr. Davis' presentation shows that local excision of breast tissue is not a hazard and that all tumors in which there is any question regarding the possibility of malignancy should be removed for diagnosis.

# MEDIASTINAL TUMORS

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AND
J. W. GALE, M.D.
MADISON, WIS.

ONLY in the past twenty years has it been possible to treat mediastinal tumors successfully. Before that the rarity of the tumors and the difficulty of accurate diagnosis, plus the lack of properly developed surgical technic, caused the mediastinum to be considered unapproachable, surgically speaking. Since symptoms were not alarming, except in cases of advanced malignant lymphomas, therapy, if any, consisted solely of irradiation. No attempt was made to determine either the type of tumor or its sensitivity to radiation. Indeed, exploration was considered only in instances in which alarming complications such as tracheal obstruction, bronchial perforation or secondary infection forced the physician to exhibit more than passive interest.

Unquestionably the rapid advances in the field of thoracic surgery and the routine use of roentgenograms of the chest have completely changed the physician's attitude toward these tumors. They certainly occur more frequently than it was formerly believed. Blades,[1] in presenting a collective review from five Army thoracic centers,[2] reported exploration of one hundred and nine mediastinal tumors, exclusive of the malignant lymphomas, over a three year period. At the Wisconsin General Hospital only fifteen nonlymphomatous mediastinal tumors were diagnosed for the thirteen year period of 1927 to 1940, whereas thirty-seven have been operated on since 1940. These explorations not only resulted in a cure of all the benign lesions, but, more important, they materially aided in the establishment of a differential diagnosis by correlating the roentgenologic observations with the surgical and pathologic findings. At present it is possible, by combining clinical and roentgenologic findings, to diagnose the tumor in approximately 80 per cent of the cases preoperatively.

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From the Department of Surgery, University of Wisconsin Medical School.

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 3, 1948.

1. Blades, B.: Mediastinal Tumors, Ann. Surg. **123**:749 (May) 1946.

2. Baxter General Hospital, Spokane, Wash.; Brooke General Hospital, San Antonio, Texas; Fitzsimmons General Hospital, Denver; Kennedy General Hospital, Memphis, Tenn., and Walter Reed General Hospital, Washington, D. C.

Mediastinal tumors per se do not provoke symptoms. Symptoms are a sequel to complications, and therefore considerable variability may be anticipated, ranging from no symptoms at all to those due to any intrathoracic lesion. Usually symptoms are related to pressure on adjacent structures such as the bronchus, esophagus or nerves. Thus, when present, the most common symptoms are pressure, dyspnea, cough and pain. In rare instances cysts may perforate into adjoining viscera, creating considerable expectoration and becoming secondarily infected.

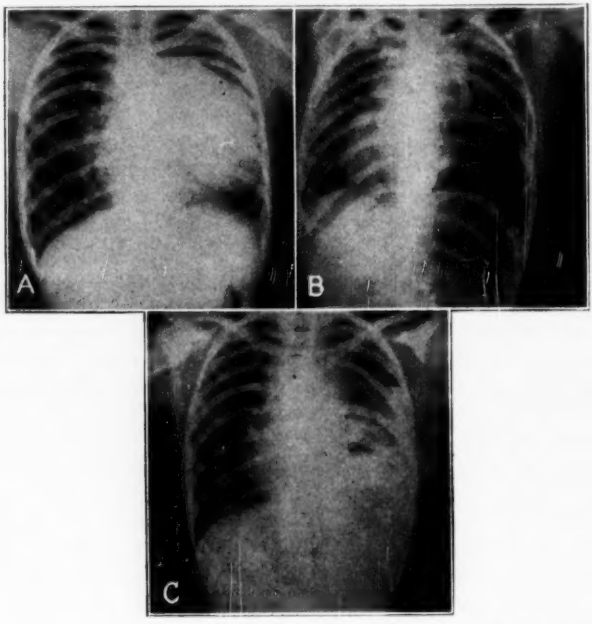


Fig. 1.—Benign teratoma attaining great size without manifesting symptoms. *A*, preoperative roentgenogram; *B*, two days after resection; *C*, three months later, showing pulmonary expansion and elevated diaphragm.

Benign tumors may attain great size without producing symptoms. This is well demonstrated in a case (fig. 1) in which a 30 year old man with a teratoma filling one half to two thirds of his left thoracic cage had no complaints. The presence of paralysis of the vocal cords or of Horner's syndrome is considered indicative of a malignant process. However, occasionally one is pleasantly surprised to find at exploration a benign tumor producing these changes. A 28 year old woman (fig. 2) had a large bronchogenic cyst which produced a change in voice and

a cough resembling the roar of a sea lion. Postoperatively her voice and cough returned to normal pitch.

The type and distribution of mediastinal tumors as found at surgical exploration are shown in the following table. We have also taken the liberty of including Blades's collective report from the five army thoracic centers. The two series total 145 cases of mediastinal tumors. The incidence of the various types of tumors is listed.

Although a rather large number of tumors was noted, each of the four subdivisions of the mediastinum was dominated by one or possibly

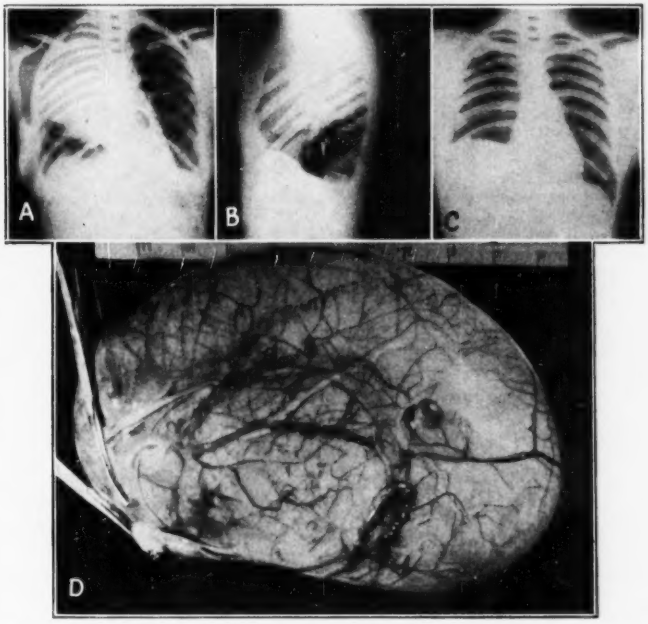


Fig. 2.—Benign bronchogenic cyst simulating malignant tumor because of vocal cord paralysis. *A* and *B*, anteroposterior and lateral views demonstrating size and location of cyst. Right lung is compressed into lower one third of right pleural space. *C*, six months postoperatively lung has expanded to fill entire thoracic cage. *D*, specimen removed.

two tumors. Thus, purely on the basis of position, fairly accurate prognostication can be made, because 75 per cent of the anterior mediastinal tumors are of dermoid derivation; 50 per cent of the mid-mediastinal tumors are bronchogenic cysts, and 92 per cent of the posterior mediastinal tumors originate from neurofibromas. Frequently these three tumors will extend to or occupy a superior mediastinal

position. Thyroid adenomas and thymomas will be found to constitute 65 per cent of the tumors occupying the anterior half of the superior mediastinum. A higher incidence of correct diagnosis can be made if close cooperation exists between clinician and roentgenologist. Invaluable aid in the differential diagnosis can be derived by utilizing the patient's age, clinical course, physical findings and response to clinical tests and therapy. For example, a single tuberculous gland may simulate a benign mediastinal tumor, but a history of protracted influenza,

*Incidence of Mediastinal Tumors According to Location*

| | Our Series | Brian Blades's Collective Report of Five Army Thoracic Centers | Total |
|---|---|---|---|
| Anterior Mediastinum: | | | |
| Benign—dermoid and teratoma | 11 | 14 | 25 |
| Malignant teratoma | 1 | 6* | 7 |
| Pericardial cyst | 2 | 10 | 12 |
| Midmediastinum: | | | |
| Bronchogenic cyst | 2 | 23 | 25 |
| Lipoma | 1 | 3 | 4 |
| Gastric cyst | 1 | 0 | 1 |
| Aneurysm | 1 | 0 | 1 |
| Benign lymphomas | 1 | 5* | 6 |
| Malignant lymphomas | 1 | 2* | 3 |
| Hodgkin's disease | 1 | 4* | 5 |
| Posterior Mediastinum: | | | |
| Benign primary nerve tumor | 6 | 29 | 35 |
| Malignant primary nerve tumor | 1 | 1* | 2 |
| Leiomyoma or esophageal cyst | 1 | 1 | 2 |
| Fibroma | 0 | 1 | 1 |
| Superior Mediastinum: | | | |
| Thyroid adenomas | 3 | 2 | 5 |
| Thymomas | 1 | 4* | 5 |
| Malignant thymoma | 1 | 2 | 3 |
| Cystic hygroma | 1 | 0 | 1 |
| Tuberculomas | 0 | 2 | 2 |
| Total | 36 | 109 | 145 |

* Extensive invasion of the tumor precluded even partial removal in all except 3 cases.

associated with loss of weight, intermittent fever, weakness and a positive reaction to the Mantoux test would not be in keeping with a benign tumor. In another instance a mediastinal tumor in a patient manifesting loss of weight, weakness, malaise and possibly peripheral lymph glands, would indicate malignant lymphoma or possibly a metastatic malignant growth in the mediastinum. An anterior-superior mediastinal tumor in a child would be consistent with thymic hyperplasia, whereas in an adult a thymoma or a thyroid adenoma would be the primary consideration.

In the diagnosis of mediastinal tumors, free rein should be given the roentgenologist to obtain those roentgenologic studies he considers

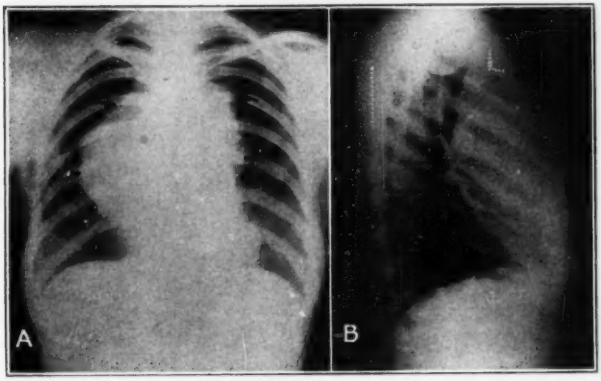


Fig. 3.—The bilateral mediastinal enlargement ordinarily found in lymphomas, in contrast to unilateral enlargement in benign tumors.

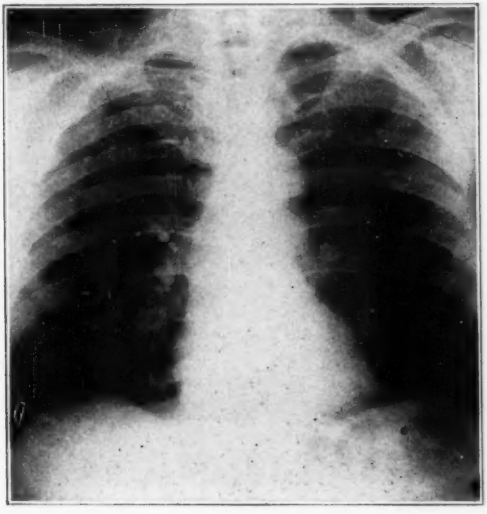

Fig. 4.—Atypical unilateral Hodgkin's granuloma simulating benign tumor.

necessary and desirable. Fluoroscopy is advisable as a preliminary study, and after pneumothorax it may demonstrate tumor pulsation. Posteroanterior and lateral roentgenograms are mandatory to determine the size and location of the tumor. An oblique view occasionally is required to locali e a lesion. Bronchograms outline the tracheobronchial tree

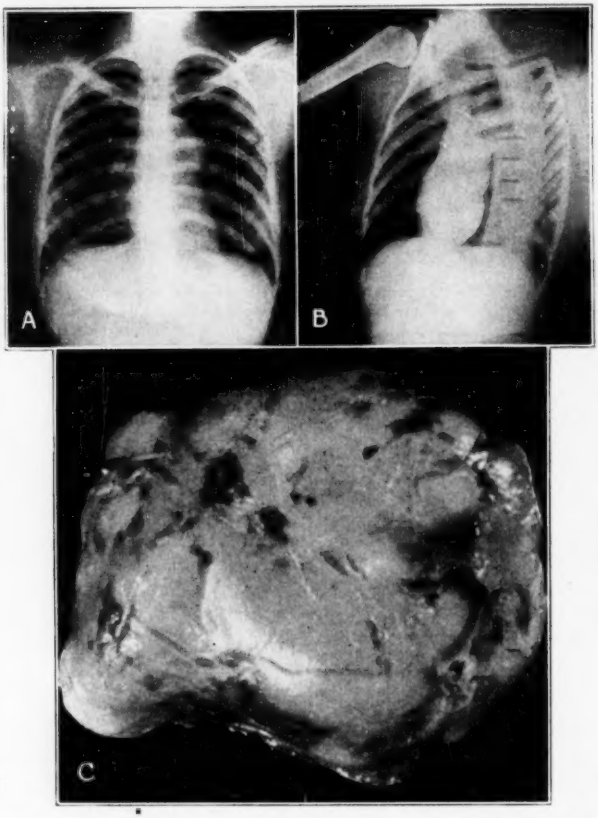


Fig. 5.—Atypical unilateral small cell lymphosarcoma simulating a benign tumor. *A* and *B*, tumor in posterior mediastinum; *C*, photograph of resected specimen.

and show the relationship between it and the tumor. Pneumothorax is exceedingly valuable in determining whether the tumor arises from the lung, diaphragm, pericardium or mediastinum. Angiograms may be considered if an aneurysm is suspected and no pulsations of the tumor

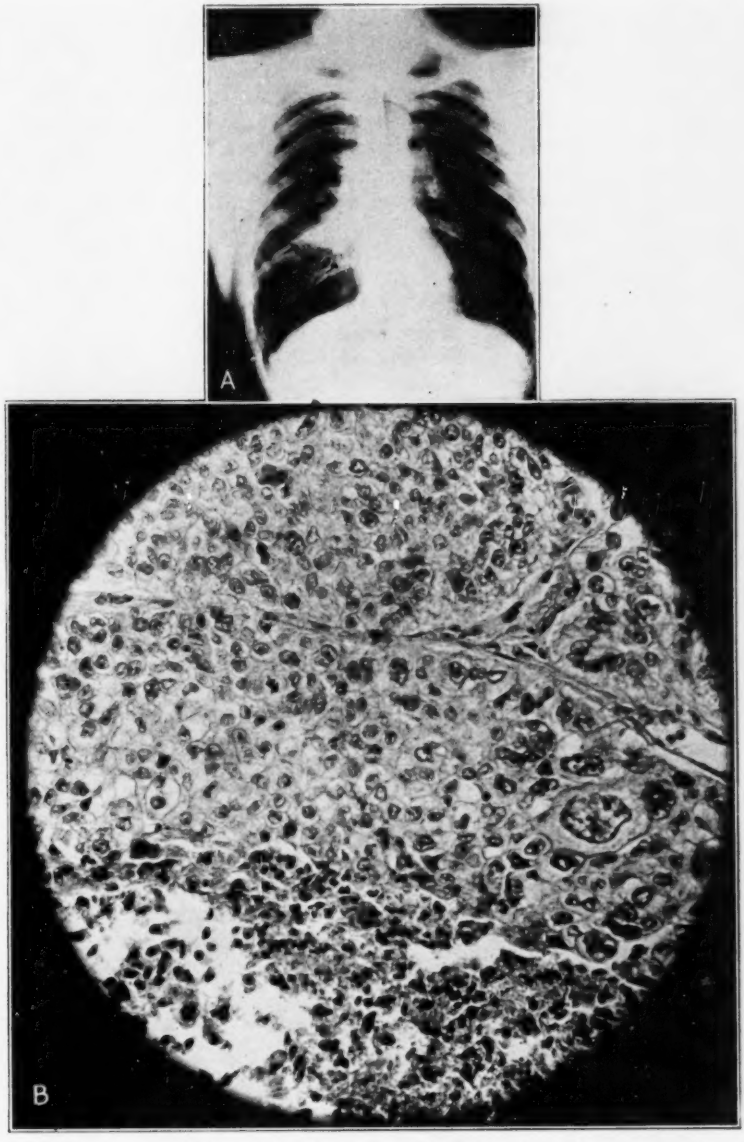


Fig. 6.—*A*, typical hazy, irregular outline of bronchogenic carcinoma (arrows); *B*, microscopic section.

are noted on fluoroscopy. Esophageal swallow of barium may demonstrate attachment or relationship of a tumor to the esophagus, trachea or bronchus.

In the establishment of a diagnosis of a resectable mediastinal tumor, malignant lymphomas and bronchogenic carcinoma are often difficult to exclude. Ordinarily, lymphomas appear as bilateral enlargements in the mediastinum with a sharp margin but irregular outline (fig. 3). In addition, glands may be palpated peripherally, and the clinical course is progressively downhill. Occasionally, atypical lymphomas appear as enlargement of a solitary gland without peripheral evidence of nodal enlargement. These cannot be definitely differentiated from benign mediastinal tumors. There were 2 such tumors in our series, one a Hodgkin's granuloma and the other a small cell lymphosarcoma (figs. 4 and 5). Both lesions were resected. The patient with

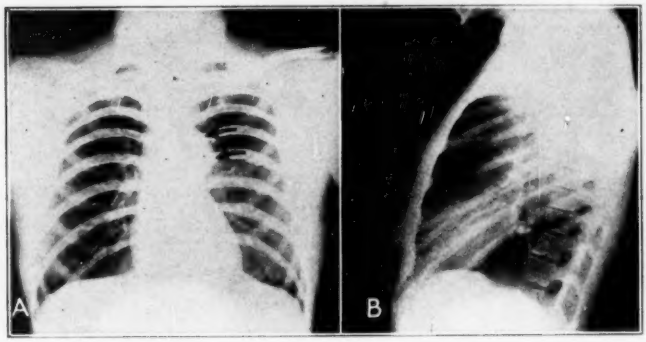


Fig. 7.—Small dermoid situated in upper anterior mediastinum (arrows).

Hodgkin's disease died a year and four months after operation from a coronary occlusion. Postmortem examination showed no evidence of Hodgkin's disease anywhere in the body. In the second case there was no evidence of recurrence one year postoperatively. The findings and results in these rare and unusual cases of unilateral malignant lymphomas are in line with those reported by Evans and Haight [3] and Bradford, Mahon and Grow.[4] Whether or not a cure has been effected in these cases only time can tell.

Bronchogenic carcinoma situated at the hilus usually presents no problem since the lesion, by occluding the bronchus, produces atelectasis.

3. Evans, B. H., and Haight, C.: Surgical Removal of Unsuspected Mediastinal Lymphoblastomas, Arch. Surg., to be published.

4. Bradford, M. L.; Mahon, H. W., and Grow, J. B.: Mediastinal Cysts and Tumors, Surg., Gynec. & Obst. **85**:467 (Oct.) 1947.

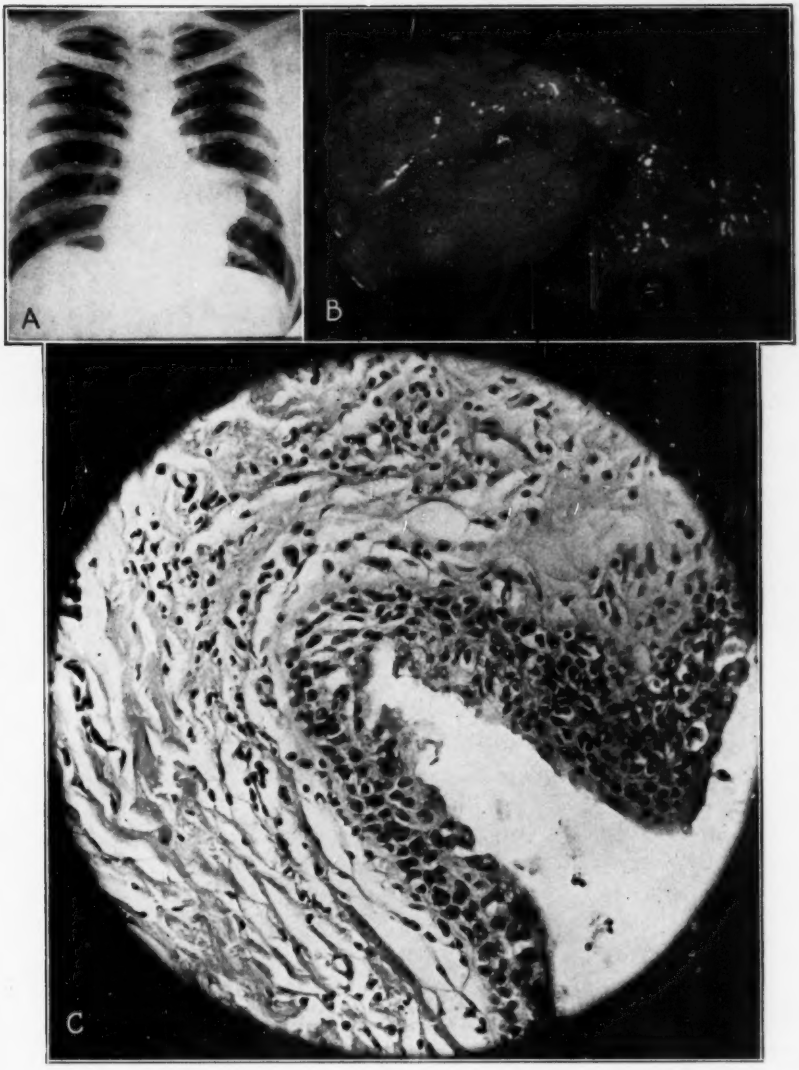


Fig. 8.—*A*, moderate dermoid situated in lower anterior mediastinum. *B*, resected specimen. Note hair protruding from a tiny opening in dermoid cyst. *C*, photomicrograph showing epidermal and mesodermal tissue.

In certain instances there is peribronchial spread and growth of the lesion toward the hilus. The dense carcinoma without atelectasis may simulate a mediastinal tumor. However, on examination of the border

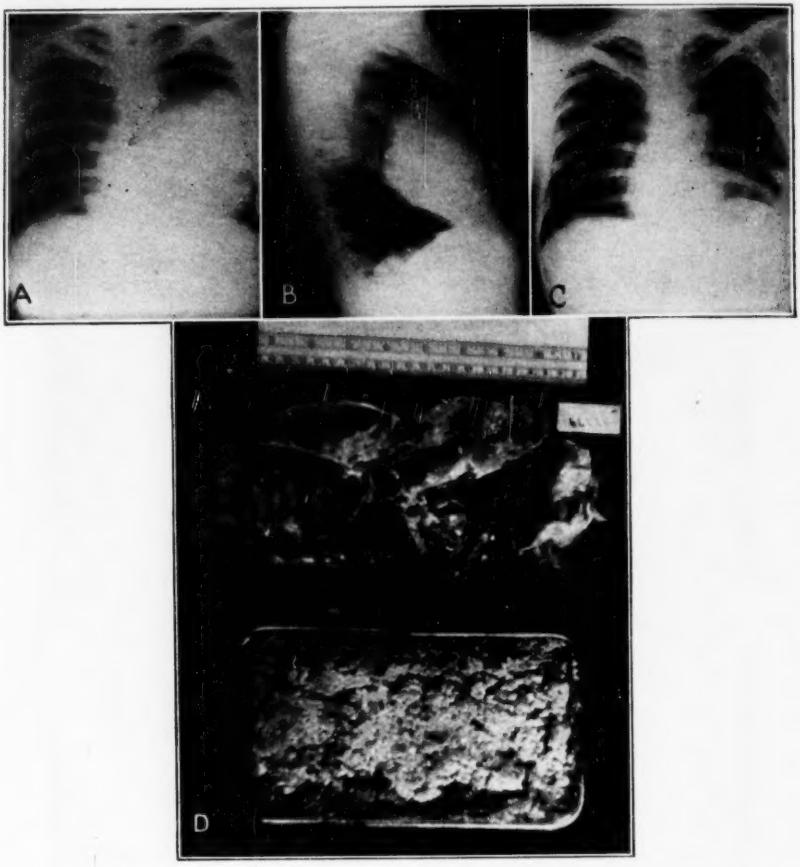


Fig. 9.—*A* and *B*, larger anterior teratoma than the one in figure 8. *C*, three months postoperatively, with lung completely expanded. *D*, resected tumor opened, containing bone and pathognomonic cholesterol crystals, shown in glass dish.

of such a bronchogenic carcinoma, a hazy and irregular outline will be observed (fig. 6).

Primary tumors of the mediastinum, other than those of lymph node origin, appear as a single lesion, round or ovoid in shape, with

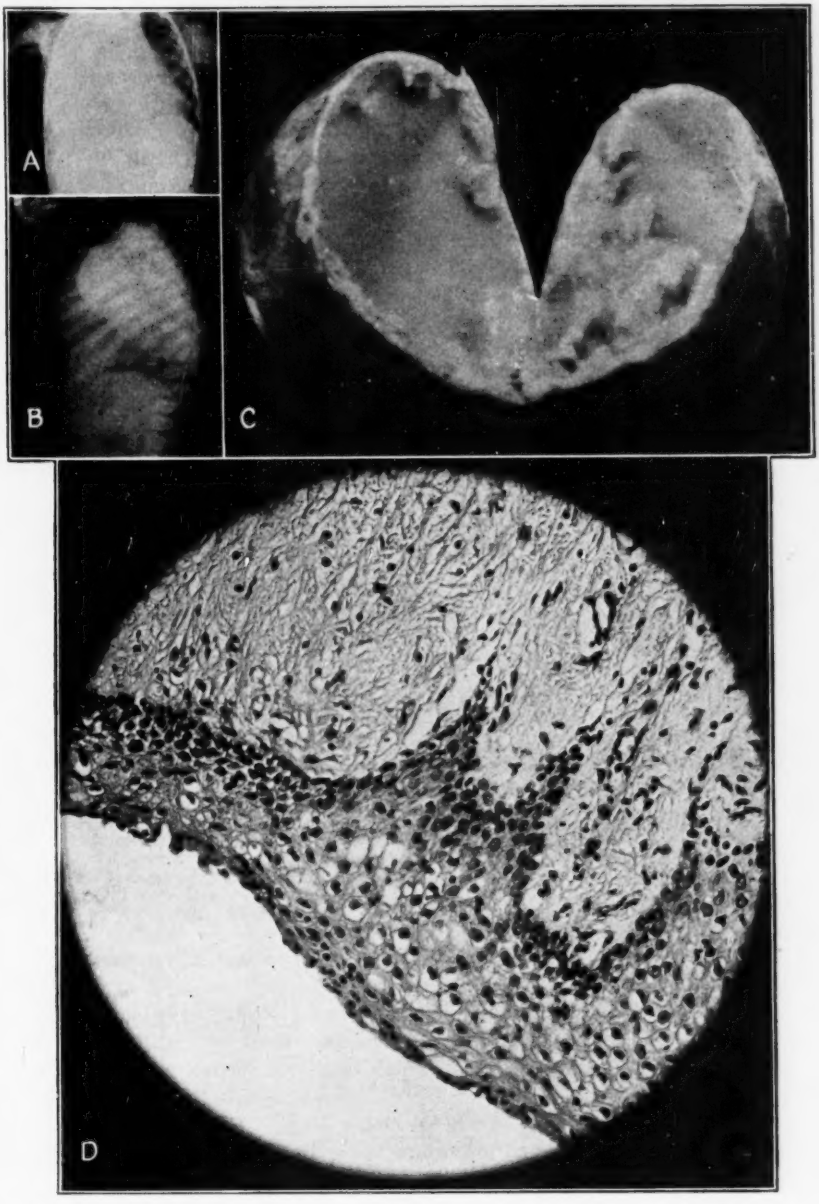


Fig. 10.—*A* and *B*, enormous dermoid in a child filling more than one half of the right thoracic cage; *C*, resected specimen opened. *D*, photomicrograph revealing typical dermoid architecture.

a sharp and distinct outline. In the anterior mediastinum the dermoid group and pericardial cysts predominate. The dermoids are found anywhere in the anterior mediastinum, and their density may vary from homogeneous to one of calcification, bone and teeth formation. The presence of bone and/or teeth is highly suggestive of teratoma (figs. 7, 8 and 9). At times dermoids may become so large as to fill practically one half of the thoracic cage (fig. 10). In such cases the exact type of tumor may be difficult to state, although one should bear in mind that dermoids and neurofibromas are the most common types of large mediastinal tumors.

In 2 cases unusual pictures were presented because the physician failed to take proper roentgenograms. In both instances only a postero-

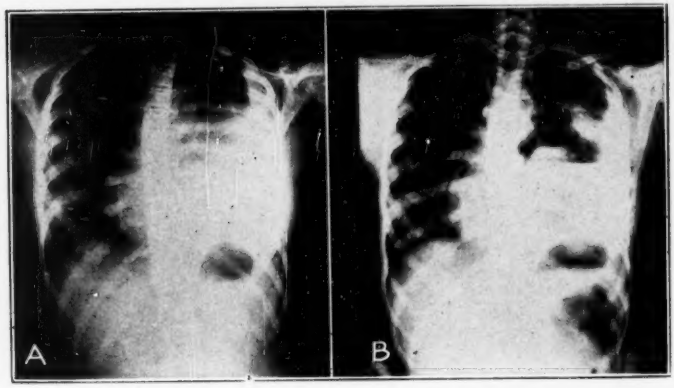


Fig. 11.—*A*, anteroposterior view. Dermoid situated anteriorly but cannot be appreciated from this view only. Child was aspirated posteriorly, with drainage of dermoid contents into general pleural space. *B*, anteroposterior view after cyst aspirated. Yellow thick fluid obtained, containing no organisms, but cholesterol crystals present. Note cholesterol above fluid level of cyst. Also the dermoid secretion in general pleural cavity can be recognized.

anterior film was taken, a diagnosis of a localized empyema made and the chest aspirated posteriorly. This aspiration produced a drainage of the dermoid cystic material into the general pleural space, and a dermoid pleural effusion resulted. At the time of the patient's admission to the Wisconsin General Hospital (fig. 11), anterior aspiration revealed sterile effusion containing cholesterol crystals—a pathognomonic sign of a dermoid. On cut section a dermoid presents a varied picture, from cystlike fluid to one containing hair, sebaceous material, bone or teeth. In rarer instances teratomas undergo malignant degeneration.

Pericardial cysts may simulate dermoids. They are along the cardiac border, usually on the left side. On fluoroscopy they transmit the cardiac pulsations, and pneumothorax definitely clinches the diagnosis since they are attached to the pericardium (fig. 12).

In the midmediastinum a variety of lesions may be seen. Oddly enough there were but two bronchial cysts in our series, whereas the collective report of Blades had twenty-three in a total of 109 cases.

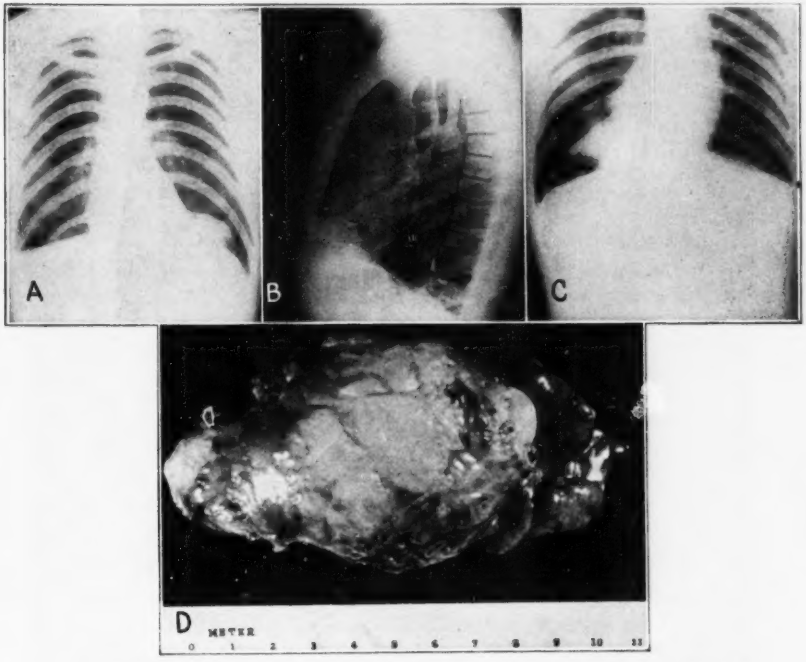


Fig. 12.—Pericardial cyst. *A* and *B*, anteroposterior and lateral views showing anterior mediastinal tumor. *C*, after pneumothorax. Tumor appears attached to pericardium. On fluoroscopy tumor transmits cardiac pulsation. *D*, resected specimen.

These tumors originate in the midmediastinum but may extend in any direction, and in some instances they attain a large size. They are single homogeneous masses of fluid density with a sharp outline. When cut, our specimens contained thin, clear fluid (fig. 13). Another cyst, simulating a bronchial one, turned out on microscopic section to be a gastric cyst (fig. 14). The microscopic section showed atypical gastric mucosa. An interesting tumor was observed near the ascending aorta,

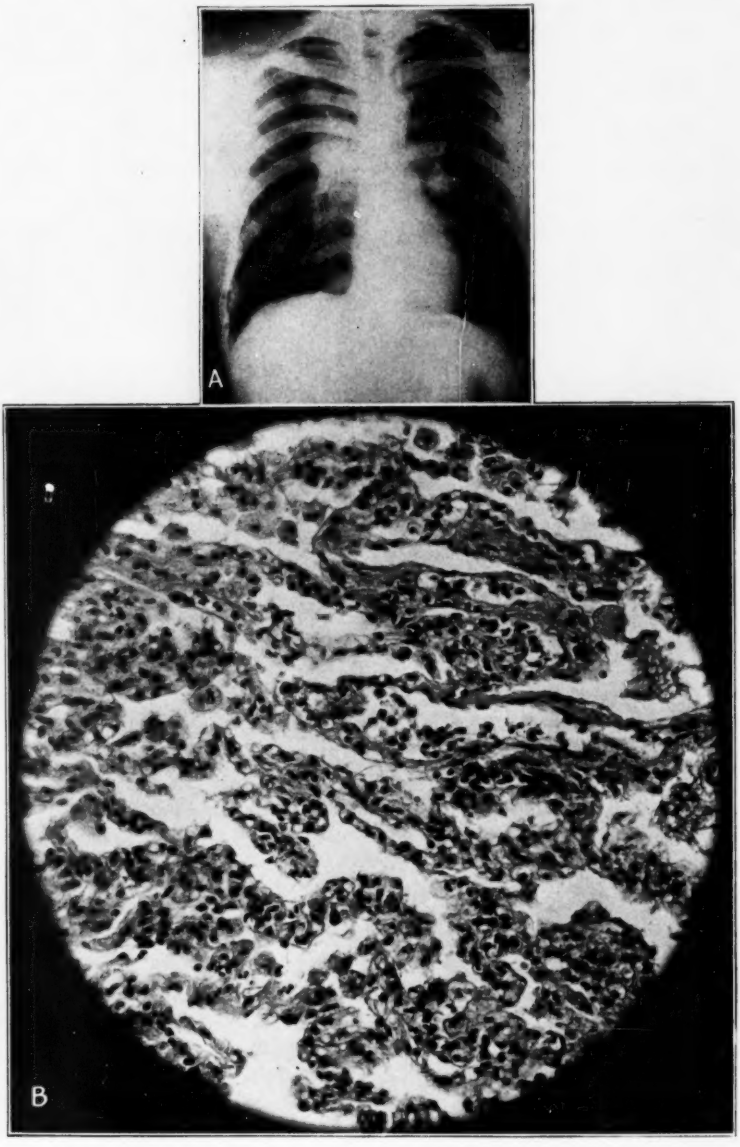


Fig. 13.—Bronchial cyst, situated in midmediastinum.

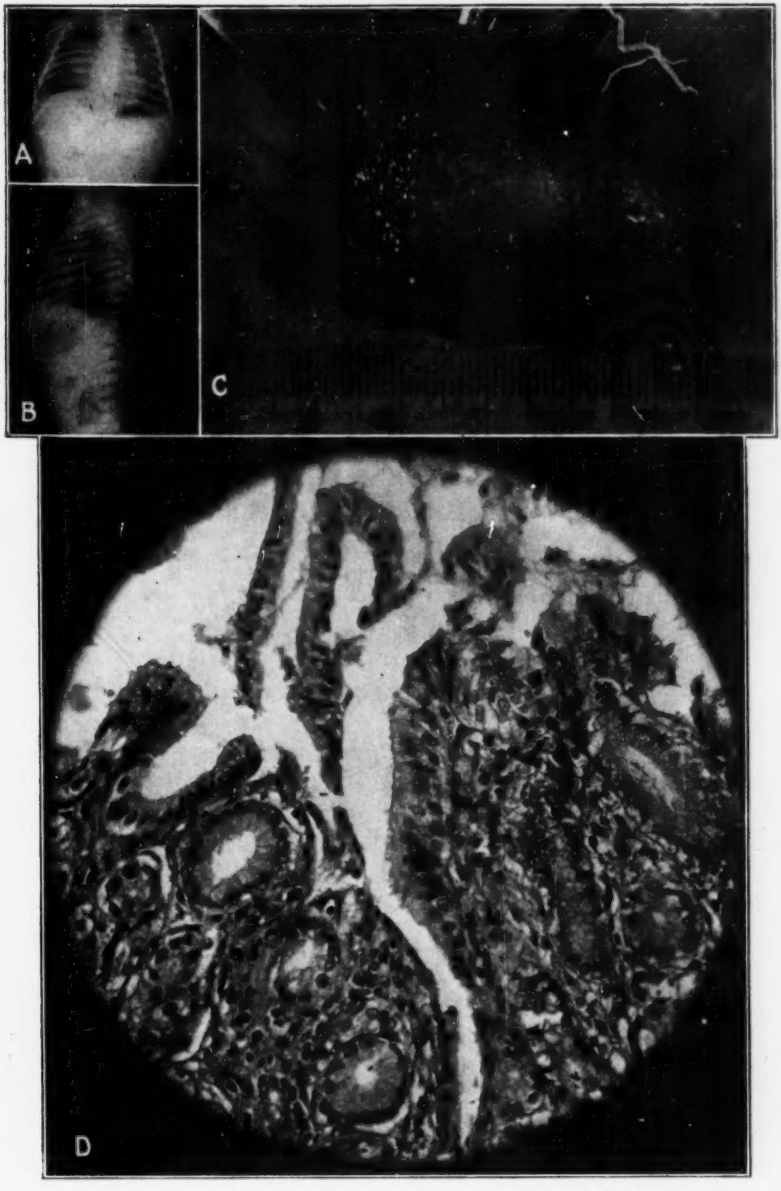


Fig. 14.—*A* and *B*, gastric cyst, showing tumor arising in midmediastinum but occupying a more posterior position; *C*, resected specimen; *D*, photomicrograph showing typical gastric mucosa.

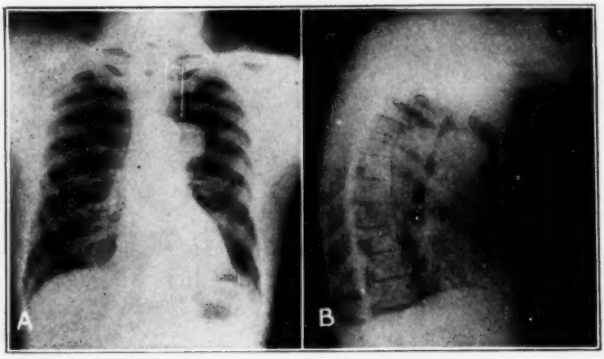


Fig. 15.—Aneurysm which after pneumothorax and fluoroscopy showed no pulsation. Note its origin from ascending aorta.

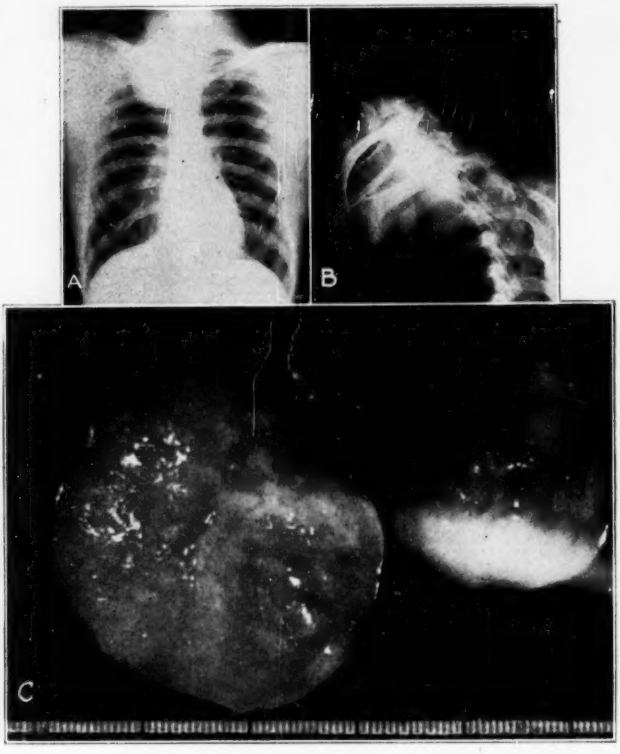


Fig. 16.—*A* and *B*, posterior mediastinal tumor shown in anteroposterior and oblique views; neurofibroma. Tumors are frequently of dumbbell shape. Note sharp outline. *C*, resected dumbbell-shaped tumor.

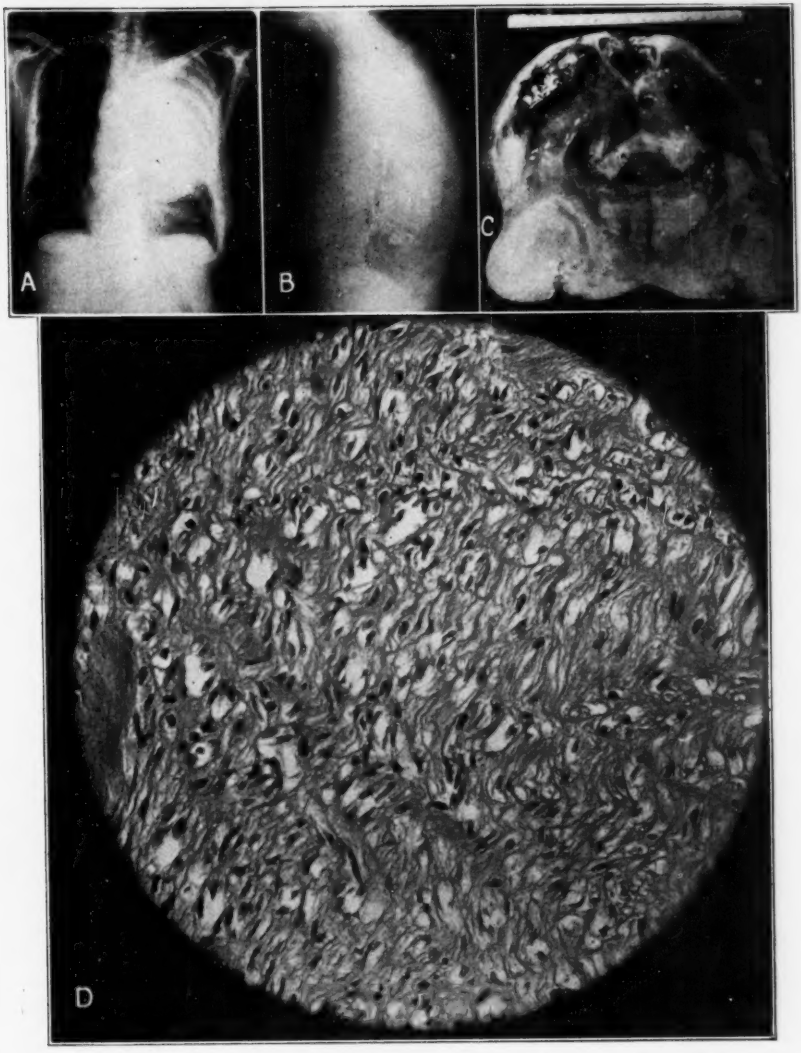


Fig. 17.—*A* and *B*, anteroposterior and lateral views reveal tremendous mediastinal tumor. In lateral view relation of tumor to bronchial tree can be visualized by iodized oil. *C*, resected tumor—cut section, showing cystic changes from degeneration. *D*, photomicrograph is typical of benign neurofibroma.

and after pneumothorax and fluoroscopy no pulsation was noted. Even at the time of surgical intervention this aneurysm of the ascending aorta showed no pulsation (fig. 15). This tumor is remarkable not only because of its failure to transmit a pulse wave but also because aneurysms of the ascending aorta are rare.

Posterior mediastinal tumors should be considered as arising from nerve tissue until proved otherwise. An extreme posterior mediastinal position and soft tissue density with sharp outline are classic (fig. 16). These tumors may also grow into the spinal canal, producing a dumbbell type of tumor which may erode a portion of the vertebrae. At

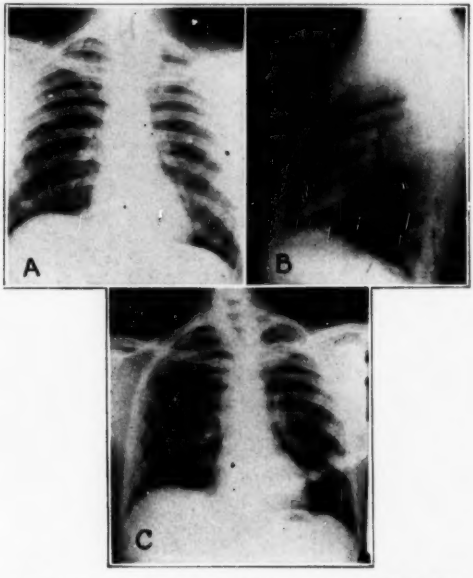


Fig. 18.—*A* and *B*, malignant neurofibroma. The patient had symptoms of expanding intracranial tumor; there were also café au lait spots and a posterior mediastinal tumor. Resection of the thoracic tumor showed malignant neurofibroma, with the cranial lesion a result of metastasis. *C*, postoperative roentgenogram.

times they may attain huge size and undergo cystic changes (fig. 17). Like teratomas, in rare instances they also undergo malignant degeneration. One of our patients was admitted with symptoms of an expanding intracranial lesion. In the course of study, typical café au lait spots were found as well as a posterior mediastinal tumor (fig. 18). The diagnosis of a possible neurosarcoma was made, and on thoracic exploration this impression was verified. In this area leiomyoma (fig. 19) or esophageal cysts are found on rare occasions.

Thyroid adenomas and thymomas are the most frequent tumors found in the superior mediastinum. Thyroid adenomas are usually seen slightly to one side of the mediastinum, appearing round with a

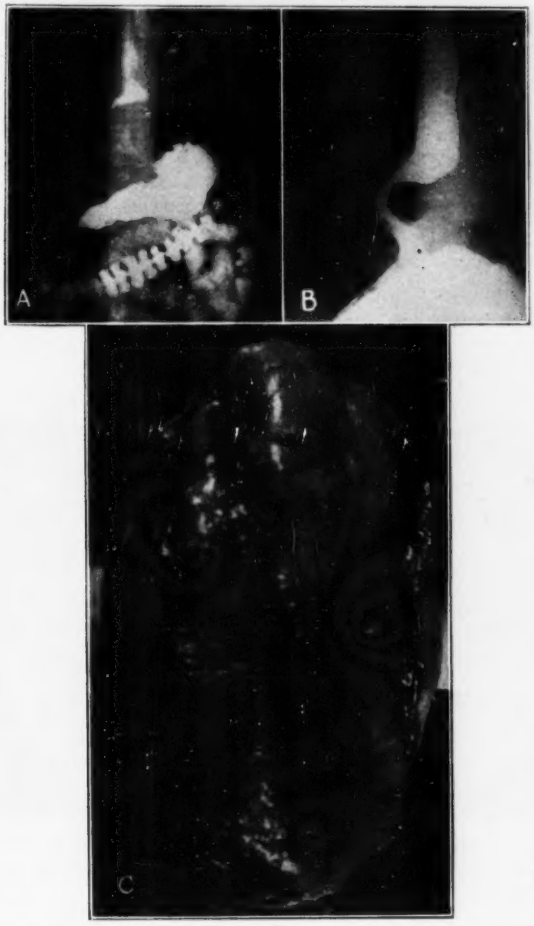


Fig. 19.—*A* and *B*, leiomyoma of esophagus. The esophagram demonstrated deviation of barium flow. *C*, resected tumor.

sharp outline, and their density may vary from soft tissue to one of calcification. On fluoroscopy they will be seen to move with swallowing (fig. 20). Recently we employed radioactive iodine to rule out

mediastinal thyroid in a case demonstrating a round tumor which moved on deglutition (fig. 21). However, the Geiger counter showed this tumor failing to take up iodine, and it was therefore assumed to be nonthyroid in origin. Exploration showed it to be carcinoma metastatic from the lung.

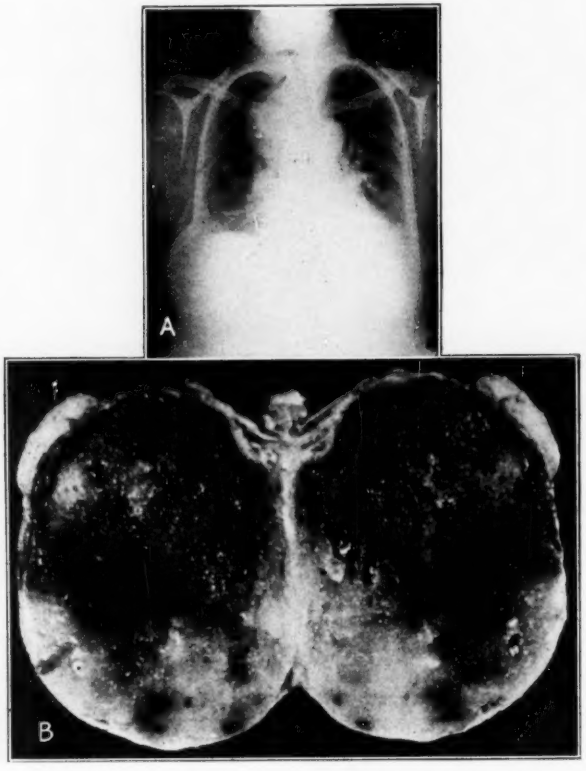


Fig. 20.—Superior mediastinal thyroid adenoma. *A*, superior mediastinal tumor. Fluoroscopy showed tumor to move on swallowing. *B*, cut section of thyroid adenoma.

Thymic tumors in the adult can be recognized by their anterior position in the superior mediastinum and their quadrilateral appearance. In our only case of thymoma the typical picture was not seen. Cystic hygromas are found in infants, and in practically all instances extension into the neck can be seen.

The therapy for mediastinal tumors consists of the judicious use of surgical treatment and irradiation. Since benign mediastinal tumors do not respond to irradiation we have taken the stand at the Wisconsin General Hospital that all unilateral mediastinal tumors should be explored. Occasionally one may remove a unilateral malignant lymphoma or a benign mediastinal tumor which has undergone malignant degeneration. In either event, exploration with resection of a portion of or the entire primary tumor offers the patient a better prognosis, because in a small percentage a cure may result or on the basis of the biopsy more specific irradiation may be offered to the patient. One must keep in mind that thoracic exploration and resection of benign tumors is a relatively simple procedure. On the other hand, when these tumors attain huge proportions, produce complications or undergo malignant

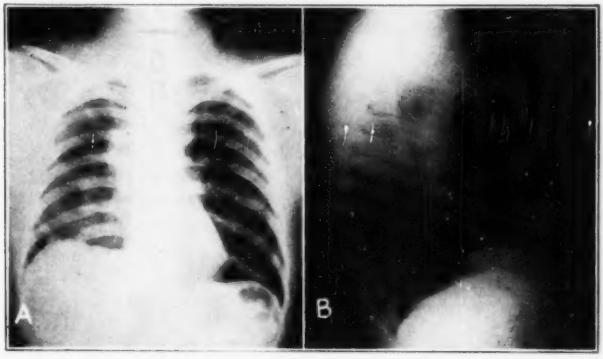


Fig. 21.—Tumor simulating possible intrathoracic tumor. Fluoroscopy showed it to move on deglutition. Radioactive iodine was administered, but the Geiger counter showed no uptake of iodine. Diagnosis of malignant tumor was then made and verified by thoracotomy and biopsy.

degeneration, surgical intervention becomes more hazardous. For malignant lymphomas with bilateral mediastinal distribution the treatment of choice at present is irradiation therapy. As in the reports of Blades and of Bradford, Mahon and Grow, there were no deaths in our series attributable to resection of a mediastinal tumor.

## DISCUSSION

Dr. S. W. Harrington, Rochester, Minn.: I wish to compliment Dr. Curreri on his excellent presentation of the series of mediastinal tumors which he is reporting for Dr. Gale and himself. Mediastinal tumors are now being recognized more frequently because routine roentgenograms are being taken by mobile units on mass groups of patients who do not have subjective symptoms. These studies have revealed many indeterminate lesions, and it is important that complete

roentgenologic and physical examinations be made on these patients to determine the type of lesion. If the findings indicate an intrathoracic tumor, surgical treatment should be considered regardless of whether or not the tumors are producing symptoms because they are potentially malignant and may undergo malignant change.

I have recently reported a series of 168 cases of intrathoracic extrapulmonary tumors which I have removed since 1925. The incidence of tumors in the different intrathoracic regions is essentially the same as that reported by Dr. Curreri, although the percentage of malignant lesions is a little higher. Of this series, approximately 20 per cent were malignant growths.

The most common tumors in the anterior mediastinum of my series were teratomas and thymomas. There were 40 teratomas, of which 15 per cent had undergone malignant change. As Dr. Curreri has pointed out, the most common tumors located in the posterior mediastinum are primary nerve tumors. In my series there were 51, of which 5 per cent had undergone malignant change.

I should also like to point out that nerve paralysis is usually caused by malignant growths, but it can occur from benign lesions when the tumor involves the recurrent laryngeal nerve. I have seen cord paralysis produced by a benign neurofibroma and also Horner's eye syndrome produced by a benign ganglioneuroma.

I thoroughly agree with Dr. Curreri and Dr. Gale in that all intrathoracic growths should be thoroughly investigated and should be removed surgically unless operation is contraindicated, as all these growths are potentially malignant.

DR. A. R. CURRERI, Madison, Wis.: I should like to thank Dr. Harrington for his discussion. It should be pointed out that he is one of the pioneers in mediastinal surgery, and his enthusiasm and results were responsible for the undertaking of this type of surgery by us.

# SUPPURATIVE DISEASE OF THE LUNGS

FRED R. HARPER, M.D.
WILLIAM B. CONDON, M.D.
AND
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DENVER

SUPPURATIVE disease of the lungs, which includes bronchiectasis, pulmonary abscess and infected pulmonary cysts, has always been a serious and confusing problem. A great deal has been written on this subject, and many forms of treatment have been recommended in order to reduce the high morbidity and mortality in this group of pulmonary lesions. It is only in the last five or six years that rapid advances in treatment, both medical and surgical, have reduced these conditions to the status of infections in other parts of the body. At the present time the diagnosis is relatively accurate, the treatment is specific and surgical intervention is safe. We feel that in the light of the present knowledge of these conditions, it might be well to reevaluate the accumulated information on the subject. We are also adding our own experience to show that when patients with these diseases are properly handled, their condition can be treated as successfully as suppurations elsewhere in the body.

The patients we are reporting on include only those on whom we have operated during the last two and one-half years since we returned from military service. During that period, we have had all the advanced methods of treatment available to us.

## PATHOGENESIS OF SUPPURATIVE DISEASE OF THE LUNGS

Our conception of bronchiectasis is based on the experimental work of Tannenberg and Pinner.[1] In that important study, using rabbits, several fundamental principles were brought out.

1. By completely obstructing a normal bronchus, true atelectasis could be produced, but this uncomplicated atelectasis did not lead to bronchiectasis or suppuration of the lungs.

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Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 3, 1948.

1. Tannenberg, J., and Pinner, M.: Atelectasis and Bronchiectasis, J. Thoracic Surg. **11**:571-616 (Aug.) 1942.

2. If partial obstruction was produced, in the presence of infection pneumonitis resulted which rapidly led to extensive saccular bronchiectasis in about four weeks.

3. Contralateral bronchopneumonia which developed in some of the rabbits with bronchiectasis did not develop into bronchiectasis in the absence of obstruction.

4. In some of the rabbits in which pneumonitis and early bronchiectasis from the presence of obstruction plus infection had developed,

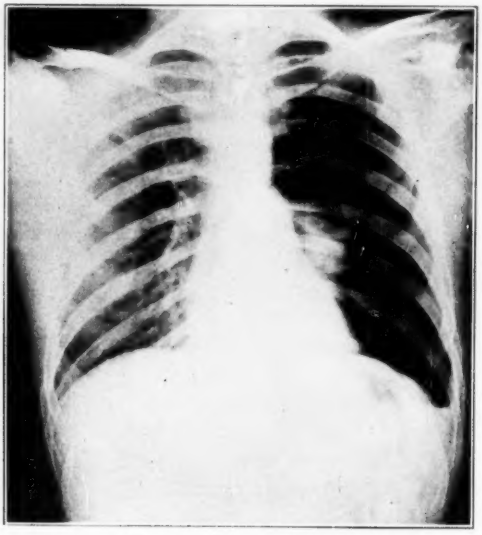

Fig. 1.—Atelectasis not complicated by infection.

the obstruction was dislodged between the seventh and tenth days. In these rabbits the lung became normal again within thirty to sixty days.

If these important experimental findings are applied to clinical bronchiectasis in human beings, some basic principles can be deducted.

1. True uncomplicated atelectasis rarely exists in human beings because sudden complete obstruction of a normal bronchus leading to a normal lung does not take place.

2. The pathogenesis of bronchiectasis in human beings is partial obstruction plus infection which causes pneumonitis (rather than atelectasis) and results in bronchiectasis.

3. Bronchiectasis can develop rapidly in about four weeks, if obstruction plus infection is present.

4. Vigorous treatment during the first and second weeks directed at removal of the obstruction and reduction of infection will result in complete healing without permanent changes in the lung.

These principles are illustrated in the following 2 cases:

The first one is an example of true uncomplicated atelectasis (fig. 1). The patient was a soldier who was shot through the chest, with resulting total collapse of the left lung. The soldier was seen by one of us three weeks after the injury. At that time he had a total pneumothorax, with high negative intrapleural pressure but no fever,

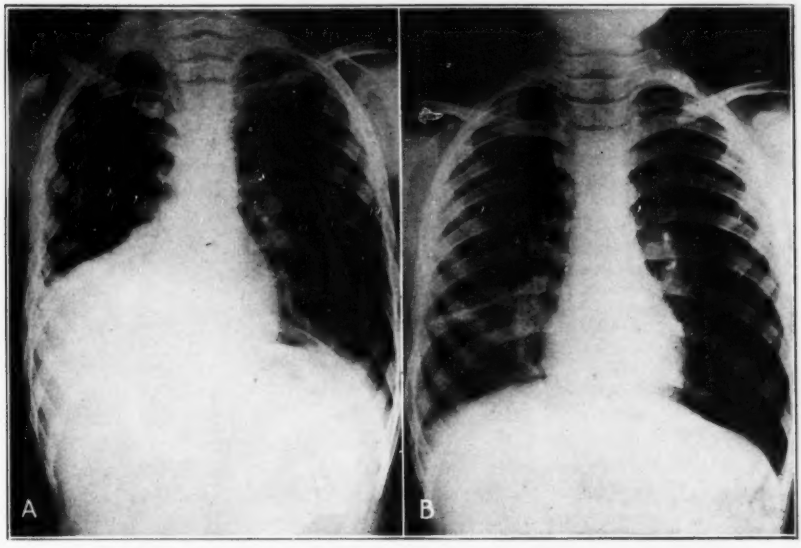


Fig. 2.—*A*, pneumonitis of middle and lower lobes of right lung following respiratory infection. *B*, reexpanded middle and lower lobes after removal of obstruction with bronchoscopy. There was no permanent damage to the lung.

leukocytosis or pleural fluid. Bronchoscopic examination was carried out, and as soon as the left bronchus was approached, a membrane was seen. Clear fluid poured out of the bronchoscope as soon as the membrane was perforated. The bronchial mucous membrane appeared normal. The next day the lung started to expand, and within four days it was completely expanded. Subsequent bronchograms showed no evidence of bronchiectasis. This unusual case is an example of total obstruction of a normal bronchus with true atelectasis but without infection. The result bore out the findings in experimental animals in that the lung expanded completely and was not damaged.

The second case illustrates the result of early treatment of pneumonitis by the establishment of free bronchial drainage. The patient was an 11 year old boy who had a respiratory infection with a persistent cough. Roentgenograms showed airless middle and lower lobes on the right side (fig. 2*A*). After one bronchoscopy the lower lobe expanded, and after a second one the middle lobe expanded and became aerated (fig. 2*B*). This child had no residual bronchiectasis because the condition was recognized early enough to establish bronchial drainage before irreversible changes had taken place.

TABLE 1.—*Origin of Bronchiectasis and Pulmonary Abscess*

| | |
|---|---|
| **Bronchiectasis** | |
| Pneumonia or children's diseases | 25 |
| Tuberculous bronchial stenosis | 12 |
| Adenoma of bronchus | 4 |
| Foreign body | 2 |
| Broncholiths | 1 |
| Unknown cause | 1 |
| **Pulmonary Abscess** | |
| Pneumonia or pneumonitis | 7 |
| Postoperative complication | 6 |
| Dental extractions | 4 |
| Foreign body | 3 |
| Tumor | 2 |
| Chest injury | 2 |
| Broncholiths | 1 |
| Swimming | 1 |
| Unknown cause | 1 |
| Total | 72 |

## RELATIONSHIP OF BRONCHIECTASIS TO PULMONARY ABSCESS

The principles underlying the development of bronchiectasis would seem to us to apply in most cases of pulmonary abscess. We agree with Samson that pulmonary abscess in general is a disease of aspiration rather than an embolic disease. In pulmonary abscess the infection is peripheral in location and the smaller bronchi are obstructed so that adequate drainage through the bronchus is difficult to obtain. However, in most cases of pulmonary abscess, as in bronchiectasis, the two main factors of obstruction and infection are present. The similar pathogenesis of the two conditions is evidenced by the fact that in our series there were many cases of bronchiectasis in which the cause was the same as that in other cases of pulmonary abscess (tables 1 and 2). For example, either bronchiectasis or pulmonary abscess resulted from pneumonia or pneumonitis, foreign body aspiration, tumors or broncholiths.

In many of our cases it was difficult to decide whether the suppurative disease of the lungs should be classified as bronchiectasis or pulmonary abscess. In neglected cases of bronchiectasis pulmonary abscess and even putrid empyema will often develop. Conversely, improperly drained pulmonary abscess will result in residual secondary cavities and bronchiectasis of varying degree and extent.[2] Therefore, it would seem logical to consider bronchiectasis and pulmonary abscess together under the heading of suppurative disease of the lungs.

## TREATMENT

The treatment of suppurative disease of the lungs can be divided into four phases: (1) prevention, (2) combating the infection, (3) establishing drainage and (4) removal of irreversibly damaged pulmonary tissue.

*Prevention.*—Prevention serves its best use in careful attention to details in managing the conditions which may lead to suppurative dis-

TABLE 2.—*Types of Suppurative Disease*

| | |
|---|---|
| Bronchiectasis | 45 |
| Pulmonary abscess | 27 |
| Infected pulmonary cyst | 2 |
| Total | 74 |

ease of the lungs. For example, a child with whooping cough or measles should be carefully watched for evidence of complicating pneumonitis which may lead to bronchiectasis. The patient who is to undergo a surgical operation should be carefully examined for evidence of poor dental hygiene. Smith[3] has shown that the organisms which cause pulmonary abscess are found in abundance around infected teeth. After operation, the patient should be watched for indications of postoperative atelectasis or, more properly, obstructive pneumonitis. If this postoperative complication is corrected early, no damage to the lung will result. Foreign bodies in the bronchi should be recognized and removed at once.

*Combating the Infection.*—Since the introduction of antibiotics, the infection associated with the bronchial obstruction can be effectively combated. However, this treatment should be given early, vigorously and accurately. Smith[3] has described the organisms most commonly found in the type of pneumonitis which leads to suppurative disease

2. Kent, E. M., and Ashburn, F. S.: Pulmonary Resection for Chronic Lung Abscess, J. Thoracic Surg. **17**:523-529 (Aug.) 1948.

3. Smith, D. T.: Medical Treatment of Acute and Chronic Pulmonary Abscesses, J. Thoracic Surg. **17**:72-90 (Feb.) 1948.

of the lungs and has recommended the drugs which are most effective. He feels that the majority of pulmonary abscesses result from the aspiration of infected material from the patient's own mouth or upper respiratory tract. These aspiration abscesses he divides into pyogenic and fusospirochetal types. The fusospirochetal type of infection results most frequently in a single isolated peripheral abscess, while the pyogenic organisms more often bring about multiple small abscesses (fig. 3). The sulfonamide drugs are effective in the pyogenic type

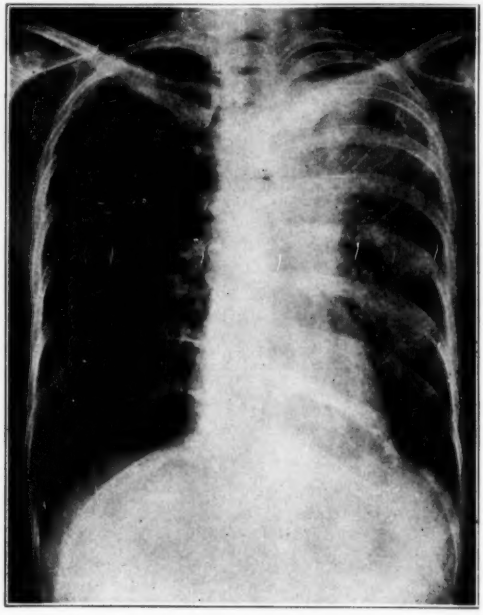

Fig. 3.—Multiple pyogenic abscess requiring pneumonectomy.

and, combined with penicillin, afford excellent treatment. In the fusospirochetal infections, penicillin should be used intensively and early, with or without supplementary arsenicals, sulfonamide drugs or streptomycin. Smith [3] has emphasized the importance of bacteriologic examination of the sputum so that the antibiotics may be administered specifically and acurately in order to obtain the best results.

*Establishing Drainage.*—As we mentioned before, obstruction to free drainage of the bronchi always accompanies the infection. Therefore, the other phase of treatment is to establish free drainage. The obstruction may follow as the result of infection, or the obstruction may precede the

infection, but it is always present and must be dealt with. Since the experimental work of Tannenberg and Pinner has given a rational basis for the time necessary to cause irreversible changes, one can judge how urgent it is to establish free drainage within one to two weeks. Therefore, suppurative disease of the lungs must be treated vigorously during the early stages.

Along with Sāmson,[4] we are of the opinion that the question of the type of organism or the question of bronchoscopy versus open drainage or the question of whether the problem is medical or surgical is all more or less beside the point when it comes to establishing drainage. It is true that pyogenic abscesses are more liable to be multiple and less amenable to open drainage while fusospirochetal or putrid infections

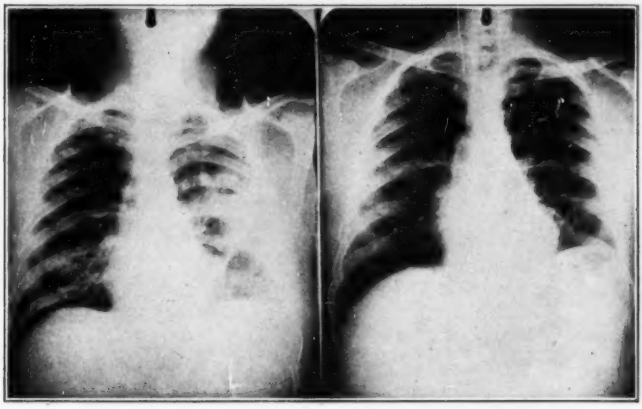

Fig. 4.—Pulmonary abscess cured with antibiotic therapy and bronchoscopy.

are more liable to be single and accessible to open drainage. However, the infection is rarely a pure type. The point is that free drainage must be established and established early. If this drainage can be established through the bronchus by the use of antibiotics and the position which will allow the best drainage, so much the better. In some cases one or more bronchoscopic treatments will establish drainage through the bronchus and result in resolution of the disease. However, time is important, and if these treatments, in the case of pulmonary abscess, are not producing clinical and roentgenologic results, they should be abandoned and drainage established externally. Specifically, a roentgenogram should be taken once a week and the first one that does not show marked and definite improvement should be evidence that the treatment

4. Samson, P. C.: Lung Abscess, Dis. of Chest **14**:79-91 (Jan.) 1948.

is inadequate. Improvement in the roentgenograms should be confirmed by clinical improvement.

A case to illustrate this treatment is one in which the patient had a large abscess, as shown in the first roentgenogram (fig. 4). He was given adequate antibiotic therapy early. After one bronchoscopy, there was free drainage through the bronchus. Subsequent weekly roentgenograms showed progressive improvement, and he improved clinically. The second roentgenogram showed that complete resolution took place without surgical intervention.

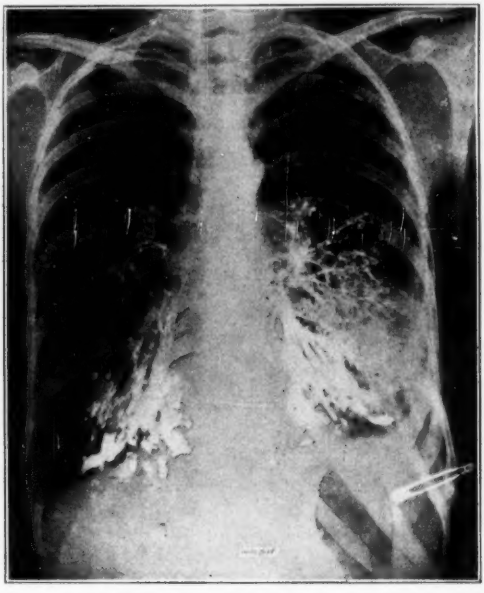

Fig. 5.—Bronchiectasis followed by pulmonary abscess and putrid empyema.

A large percentage of cases of pulmonary abscess will not respond to the treatment described. In these cases there must be adequate drainage before permanent changes, such as multiple abscess, fibrosis and bronchiectasis, occur. External drainage should be done. In other cases it is obvious that permanent changes have occurred, but the patient is too ill to warrant resection of the lung. When this occurs, external drainage should be carried out with the full knowledge that further surgical treatment will be necessary just as appendical abscesses are drained with the knowledge that subsequent appendectomy will be required. In still other cases the abscess will have been neglected until

it ruptures into the pleura, causing a putrid empyema (fig. 5). In these cases the empyema should be drained, with wide open drainage as a surgical emergency. Definitive surgical treatment can be carried out later.[5]

*Removal of Irreversibly Damaged Pulmonary Tissue.*—After a pulmonary abscess has advanced to the point where permanent changes such as multiple loculations, bronchiectasis and fibrosis have occurred, external drainage will at best be palliative. In such instances, if the condition of the patient warrants it, the diseased lung should be removed. In some cases, after external drainage the patient will not be completely well because undrained pockets and bronchiectatic areas remain. In these cases further attempts at drainage will not be successful; therefore removal of the involved lung is the only method of affecting a cure. In cases in which the obstruction cannot be relieved, as in the case of tumor, unremovable foreign body or tuberculous stenosis, the diseased lung including the obstructing lesion should be removed.

To these indications for resection should be added severe hemorrhage because external drainage will not relieve hemorrhage and may aggravate it. Some abscesses are not accessible for external drainage because of their location and should be resected. Children tolerate resection of the lung well and open drainage poorly. Resection, therefore, is to be preferred in the treatment of children. Glover and Clagett,[6] in listing eight indications for pulmonary resection in cases of abscess of the lung, include abscesses in children.

In instances of bronchiectasis the lesions are irreversible when the diagnosis is established. Therefore, removal of involved pulmonary tissue is the only method of curing the disease. It is important that accurate diagnosis of the extent of the disease be made so that the amount of tissue to be removed can be estimated before surgical intervention is undertaken. The method of determining the amount of involvement is to map out the bronchial tree with roentgenograms taken after filling the tree with iodized poppy seed oil 40 per cent (fig. 6). In making bronchograms, all five lobes should be completely filled.

We have been continuously broadening our ideas as to the amount of pulmonary tissue which can be safely removed and the age of patients suitable for surgical treatment. Previously, we felt that older persons were not suitable, but we now have a 64 year old patient in our series who withstood lobectomy well. Pneumonectomy is well tolerated in the younger age groups, but we do not believe that pneumonectomy should be undertaken if there is disease on the other side.

5. Shaw, R. R., and Paulson, D. L.: Pulmonary Resection for Chronic Abscess of the Lung, J. Thoracic Surg. **17**:514-522 (Aug.) 1948.

6. Glover, R. P., and Clagett, O. T.: Pulmonary Resection for Abscess of the Lung, Surg., Gynec. & Obst. **86**:385-394 (April) 1948.

The cases of bilateral infection offer the most difficult problem. If the disease is extensive on one side and minimal on the other side, removal of the diseased lung on the more involved side, provided it does not require a total pneumonectomy, will usually bring about 80 to 90 per cent improvement in the patient's condition. However, it is important that all the diseased lung on the more involved side be removed.

In some of the cases of extensive bilateral involvement it is best to carry the patient along on medical management. In others bilateral operation may be done.[7] It is this type of case that prompted Overholt, Woods and Betts [8] to recommend segmental resection.

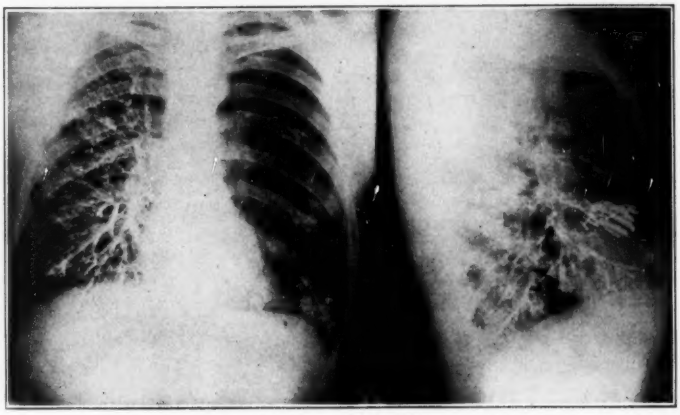

Fig. 6.—Bronchogram showing bronchiectasis of the middle lobe of the right lung. This case illustrates the importance of obtaining complete filling of all lobes.

The operation of segmental resection is based on the anatomic studies of Jackson and Huber [9] and others, who showed that the lobes are actually subdivided into segments which are in themselves anatomic units with their own blood supply and their own bronchus. If the blood supply and bronchus to the segment are dissected out, that segment can be removed from the remainder of the lobe and the uninvolved pulmonary tissue in the rest of the lobe be preserved.

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7. Bisgard, J. D., and Swenson, S. A., Jr.: Bilateral Lobectomy for Bilateral Bronchiectasis, Arch. Surg. **54**:483 (May) 1947.

8. Overholt, R. H.; Woods, F. M., and Betts, R. H.: An Improved Method of Resection of Pulmonary Segments, J. Thoracic Surg. **17**:464-479 (Aug.) 1948.

9. Jackson, C. L., and Huber, J. F.: Correlated Applied Anatomy of the Bronchial Tree and Lungs with a System of Nomenclature, Dis. of Chest **9**:319-326 (July-Aug.) 1943.

The removal of the lingula of the upper lobe of the left lung has been done in many cases since the operation was first suggested by Churchill and Belsey [10] in 1939. Clagett and Deterling [11] have described an excellent technic for segmental resection of the lingula. Resection of the lingula has been extremely successful. However, the lingula is in reality a separate lobe corresponding to the middle lobe of the right lung. It is doubtful if such a complete anatomic division exists in the other segments. Although we have performed segmental resections, we feel that there are certain inherent disadvantages of the operation.

From the pathologic standpoint, the chronic pneumonitis associated with bronchiectasis extends throughout the entire lobe and cannot be demonstrated by bronchograms. This extension of inflammatory changes beyond the obviously involved segment is even more pronounced in the case of pulmonary abscess. This remaining pneumonitis would seem to predispose to future bronchiectasis in the remaining segment and impair its future function.

From a surgical standpoint, there are objections to segmental resection. In the separation of the segments, end bronchioles are left open, thus causing air leaks which result in a high percentage of bronchial fistulas and unexpanded lungs. The incident of empyema is greatly increased, being 23.7 per cent in the series of Overholt, Woods and Betts.[8] In spite of antibiotics, empyema is a complication which adds to the risk of surgical treatment and impairs future pulmonary function. It has been shown repeatedly that the blood supply of the lung is not constant and is characterized by the frequent occurrence of anomalous vessels. In segmental resection, it would seem logical that not infrequently the blood supply to the remaining segment would be interfered with and hemorrhagic infarction and necrosis, with final shrinkage of the remaining segment, would result.

For these reasons we have been reluctant to do segmental resections, except in dealing with the lingula of the upper lobe of the left lung, until further experience shows that the procedure will be entirely satisfactory.

## RESULTS

Our results have been good in patients who did not have to be operated on as a lifesaving measure.

Table 3 shows that there were seventy-nine operative procedures performed on 74 patients. Ten of the patients were operated on for

10. Churchill, E. D., and Belsey, R.: Segmental Pneumonectomy in Bronchiectasis: The Lingula Segment of the Left Upper Lobe, Ann. Surg. **109**:481-484 (April) 1939.

11. Clagett, O. T., and Deterling, R. A.: A Technique for Segmental Pulmonary Resection with Particular Reference to Lingulectomy, J. Thoracic Surg. **15**:227-238 (Aug.) 1946.

drainage of a putrid empyema, which is an emergency operation for a severe complication. In another 10 patients external drainage of a pulmonary abscess was done. Four of these patients had a single acute abscess and recovered without residual disease of the lungs. In the other 6 the abscess was drained externally as an operation of expediency because the patient was not able to stand a resection of the lung at the time. Five of these 6 underwent resection of the lung at a later date. With the exception of the 4 with acute abscesses, in all the

TABLE 3.—*Operative Procedures*

| | |
|---|---|
| Lobectomy | 55 |
| Pneumonectomy | 5 |
| Drainage of pulmonary abscess only | 4 |
| Drainage of putrid empyema | 10 |
| Drainage of pulmonary abscess followed by lobectomy | 5 |
| Total | 79 |

TABLE 4.—*Types of Resection*

| | |
|---|---|
| **Lobectomy (entire lobe or lobes removed)** | |
| Lower lobe on left side | 11 |
| Lower lobe on right side | 11 |
| Upper lobe on right side | 5 |
| Middle lobe on right side | 5 |
| Middle and lower lobes on right side | 4 |
| Upper lobe on left side | 4 |
| **Segmental Resection** | |
| Lower lobe and lingula on left side | 12 |
| Lingula alone | 1 |
| Apical segment on left side | 1 |
| Basal segments on left side | 1 |
| Pneumonectomy | 5 |
| Total | 60 |

aforementioned patients the disease had progressed too far. Palliative rather than definitive surgical treatment had to be given, with the result that there were 8 patients with persistent fistulas, 5 of whom required subsequent definitive operations, with 2 deaths.

Tables 4 and 5 show that fifty-five lobectomies and five pneumonectomies were performed in a total of sixty pulmonary resections for suppurative disease of the lungs. All the patients recovered. There were only a few complications, none of which was permanently disabling, and no deaths in this series. The operations were elective so that the patients could be carefully selected for their ability to stand the surgical procedure and carefully prepared for operation at an optimum time.

The point which our results emphasize is that if the patients with suppurative disease of the lungs are carefully followed and vigorously treated from the inception of the disease, the serious complications can be avoided and operations of necessity, which are dangerous operations, will not have to be done.

Resection of the lung can carry a low morbidity and mortality if it is done on patients who are in good general condition. Therefore, the most conservative course seems to be to remove the lung as soon as it is apparent that the disease has progressed to the stage at which it is irreversible.

## CONCLUSIONS

Suppurative disease of the lungs results from obstruction to the free drainage of the bronchus plus infection. If the obstruction and infection are allowed to remain for a period of weeks, irreversible damage to the lung in the form of bronchiectasis or abscess will follow.

TABLE 5.—*Results*

| | Number | Number of Complications | Atelectasis | Empyema | Bronchial Fistula | Recovered | Died |
|---|---|---|---|---|---|---|---|
| Lobectomy | 55 | 48 | 4 | 2 | 1 | 55 | 0 |
| Pneumonectomy | 5 | 4 | 0 | 1 | 1 | 5 | 0 |
| Drainage of abscess | 5 | 4 | .. | .. | .. | 4 | 1 |
| Drainage of empyema | 10 | 1 | .. | 10 | 8 | 9 | 1 |

On the other hand, if free drainage and vigorous treatment with antibiotics are instituted early, the inflammatory process is reversible and the lung will not be permanently damaged. When irremovable obstruction exists or permanent damage has occurred, the treatment is resection of the diseased portion of the lung. As shown by our experience, the removal of diseased pulmonary tissue is no more hazardous than removal of other diseased organs and should be undertaken as soon as a definite diagnosis has been established.

## DISCUSSION

DR. A. R. CURRERI, Madison, Wis.: At the Wisconsin General Hospital we would be in practically complete agreement with Dr. Harper. A diagnosis of bronchiectasis shortly after virus pneumonia may cause later embarrassment. During the war I was invited to review some roentgenograms at an army hospital, and I found a group of patients manifesting typical roentgenologic evidence of bronchiectasis. Much to my surprise many of these patients showed no roentgenologic evidence of bronchiectasis three months later. It would appear, therefore, that for a short period following virus pneumonia one may find roentgenologic evidence of bronchial dilatation which does not represent true bronchiectasis. If we accept the theory that the bronchial wall is destroyed in bronchiectasis, we then

preclude the possibility of a normal bronchogram. We have not encountered such reversible types of bronchiectasis at the Wisconsin General Hospital.

I should like to support Dr. Harper's thesis against segmental resection. Theoretically, segmental resection sounds good; but one often finds considerable pneumonitis throughout the involved lobe, and therefore residual bronchiectasis may be found at a later date in the remaining portion of the lobe after segmental resection.

Furthermore, in the presence of acute inflammatory reaction about the hilus it is often extremely difficult to determine which bronchus is supplying the diseased portion of the lobe. This may result in the removal of the wrong segment or in incomplete resection of the involved segment. Another disadvantage of segmental resection is that often it becomes necessary to leave a long bronchial stump, and the patient, even though partly relieved of symptoms, still has considerable morning cough and expectoration because of accumulation of mucus in the residual stump.

For chronic pulmonary abscess we have continued to favor resection more frequently in the past ten years. This thought is predicated by the fact that even after drainage of peripheral abscess one often finds, at a later date, residual bronchiectasis adjacent to the abscess area.

In cases of unilateral congenital pulmonary cysts we continue to resect the involved lobe or lobes. This type of treatment has the advantage of completely eliminating the pathologic process at one sitting. This approach is used for chronic pulmonary abscess for the same reason, and, in addition, fewer postoperative complications in the form of hemorrhage and bronchopleural fistulas are encountered.

Col. J. H. Forsee, Denver: These two papers have brought to our attention two very important subjects in the field of thoracic surgery. We have not been as successful at Fitzsimons General Hospital, Denver, in making a preoperative diagnosis in mediastinal tumors as are Dr. Gale and Dr. Curreri. However, we have been firmly of the opinion that these tumors and lesions of nondiagnosed character must be explored. Of some 250 lesions for which exploratory thoracostomies were performed, including lesions in the mediastinum and lung, which were not diagnosed preoperatively, 20 per cent have been found to be malignant.

In regard to suppurative disease of the lung, we are in entire agreement with Dr. Harper's splendid paper and his excellent results. Since March of 1946 we have performed a consecutive series of more than 150 lobectomies for bronchiectasis, in which the lower lobe of the left lung and the lingula, the lower and middle lobes of the right lung or the lower lobes alone and, in a few instances, the upper lobes were removed, without a death.

There was one thing that Dr. Harper did not mention, and I am sure it was only time that prevented it, and that is that chronic suppurative diseases of the lung are not infrequently associated with bronchogenic carcinoma. Therefore, we believe that suppurative diseases must include, in addition to the usual classification, bronchogenic carcinoma.

Dr. Fred R. Harper, Denver: I want to thank Colonel Forsee and Dr. Curreri for their excellent discussions. In answer to Colonel Forsee's question, we excluded the cases of carcinoma, although of course it is well known that carcinoma is one of the common causes of pulmonary abscess. However, we did include the benign tumors which we classed as irremovable obstructions resulting in pulmonary abscess or bronchiectasis.

# HERNIA INTO THE UMBILICAL CORD AND OMPHALOCELE (AMNIOCELE) IN THE NEWBORN

CLIFFORD D. BENSON, M.D.
GROVER C. PENBERTHY, M.D.
AND
EDWARD J. HILL, M.D.
DETROIT

THERE has been a tendency to classify congenital malformations of the umbilicus or the supraumbilical region of the abdomen through which there is a herniation of abdominal viscera into a sac covered by peritoneum and amniotic membrane as omphalocele. The use of this all-inclusive term has led to some confusion in evaluating results of surgical treatment.

We feel that the term omphalocele or amniocele should be restricted to those congenital defects in which there is herniation of the abdominal viscera into a sac covered by peritoneum and amniotic membrane through the umbilical and supraumbilical portion of the abdominal wall. In contrast, a hernia into the umbilical cord has a defect limited to the umbilical opening. The defect is practically always less than 4 cm. in diameter, and the sac covered by peritoneum and amniotic membrane usually contains only loops of small bowel. Thus, one can conclude that a hernia into the umbilical cord with its small defect does not present a serious problem to the surgeon, but the true omphalocele with wide separation of the recti muscles and fascia does present a formidable problem in regard to its surgical management.

The incidence of hernia into the umbilical cord and omphalocele has been estimated to be about 1 : 6,000 births. It is important for the obstetrician to recognize this lesion to avoid damaging the contents of the sac in clamping or tying the umbilical cord. It is essential that operative treatment be undertaken within a few hours after birth because there is a tendency for the amniotic sac to disintegrate or rupture, with resulting peritonitis and subsequent fatal outcome. Unfortunately, omphaloceles have been looked on by some physicians as a situation not remedial by surgical means. This attitude has no doubt been due in part to former attempts at closure of these defects

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From the Surgical Services of the Children's Hospital of Michigan, Harper Hospital and Wayne University College of Medicine.

by layer closure in one stage which resulted in the loss of the infant in twenty-four to forty-eight hours from respiratory or circulatory embarrassment. These infants tolerate ether anesthesia and operative intervention when judgment is used as to whether a one or a two stage type of closure should be adopted.

### EMBRYOLOGIC ASPECTS

There have been many theories in regard to the etiology of omphalocele, the most common of which have been the following: 1. The formation of an omphalocele is probably due to an arrest or retardation in the development of the abdominal cavity at the third month of fetal life.[1] The authors who propose this theory feel that the abdomen does not develop rapidly enough and therefore some abdominal viscera will remain in the base of the umbilical cord because of insufficient room within the abdomen. 2. It is thought to occur in the third month of fetal life, the cause being due to the disparity between the abdominal cavity and the abdominal viscera which has resulted from retarded development of the abdominal parietes.[2] 3. Probably the most important and significant contribution has been that made by Margulies,[3] who based his opinions largely on the work of Pernkoff, Politzer and Sternberg. The latter authors studied the formation and closure of the anterior abdominal wall in normal human embryos. Margulies, from a review of this excellent work, stated that this structural defect is confined to the third week of embryonal development, while the formation of hernias into the umbilical cord develops in the eighth to tenth week and shows normal anatomy of the upper abdominal aponeurosis and the recti muscles. Pernkopf's work, as reviewed by Margulies,[3] demonstrated that the recti muscles do not take an active part in closure of the abdominal wall but remain V shaped and diastatic even after closure of the umbilical ring and retraction of the intestine from the extracelomic cavity, and he concluded that once the supraumbilical part of the abdominal wall has been formed normally in the third week of fetal life no herniation covered by amnion can develop at this location.

### HERNIA INTO THE UMBILICAL CORD

Hernia into the umbilical cord is a herniation of abdominal viscera through the umbilical ring. The sac is covered by peritoneum and

1. Gross, R. E., and Blodgett, J. B.: Omphalocele (Umbilical Eventration) in the Newly Born, Surg., Gynec. & Obst. **71**:520, 1940.

2. Ladd, W. E., and Gross, R. E.: Abdominal Surgery in Infancy and Childhood, Philadelphia, W. B. Saunders Company, 1941.

3. Margulies, L.: Omphalocele (Amniocele), Am. J. Obst. & Gynec. **49**: 695, 1945.

amniotic membrane, but the umbilical defect is practically always 4 cm. or less in diameter. The sac usually contains only loops of small bowel (figs. 1 and 2). A resection of the sac, replacement of viscera into the peritoneal cavity and closure of the umbilical defect present no problem to the surgeon. The repair is that used for the ordinary umbilical hernia. The prognosis is excellent in this group as to life and a firm abdominal wall after primary layer closure. Other congenital abnormalities within the sac may alter the prognosis, as illustrated by the patient in case 3 (fig. 3).

In the group of 3 patients with hernia into the umbilical cord, the defect in the umbilical ring measured 4 cm. in 2 and 3.5 cm. in the other.

Fig. 1 (case 1).—Hernia into umbilical cord showing evisceration of the small bowel because of rupture of the amniotic sac at the time of delivery.

In 2 of the patients (cases 1 and 2), who were brother and sister with an interval of two years between their births, there was a herniation of multiple loops of small bowel. One patient (case 1) had a rupture of the sac previous to coming to the operating room. In these patients the sac was excised and the loops of small bowel replaced in the peritoneal cavity, primary layer closure was accomplished with no tension and uneventful recovery occurred. The third patient in this group (case 3) had a defect of 4 cm., but within the sac, in addition to small bowel, there was a large Meckel diverticulum and atresia of the terminal ileum. The sac and Meckel's diverticulum were excised and an ileoileoanastomosis performed, the atresia being sidetracked. The postoperative course was satisfactory for forty-eight hours, when distention and a shocklike syndrome developed. After supportive treat-

ment the abdomen was reopened, and gangrene of the ileum secondary to volvulus and mesenteric vascular occlusion was found. The infant's condition precluded any attempt at resection, and death ensued. Postmortem examination revealed (1) anomalies of the left carotid artery,

Fig. 2 (case 1).—Photograph of patient one week after surgical excision of sac and primary closure of the umbilical defect.

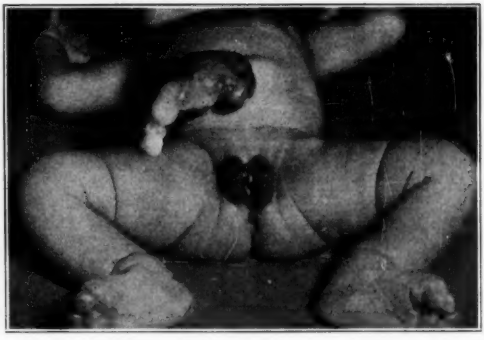

Fig. 3 (case 3).—On preoperative examination this appeared to be a simple hernia into the umbilical cord, but at operation, four hours after delivery, the sac contained not only small bowel but a large Meckel diverticulum and atresia of the terminal part of the ileum.

(2) patent ductus arteriosus, (3) volvulus of the intestine, (4) atresia of the terminal ileum, (5) gangrene of the ileum secondary to mesenteric vascular occlusion and (6) intraperitoneal abscess.

### OMPHALOCELE (AMNIOCELE)

Omphalocele or amniocele is a herniation of abdominal viscera through a defect which includes not only the umbilical ring but the supraumbilical portion of the abdominal wall, with wide separation of the recti muscles and fascia and the sac covered by peritoneum and

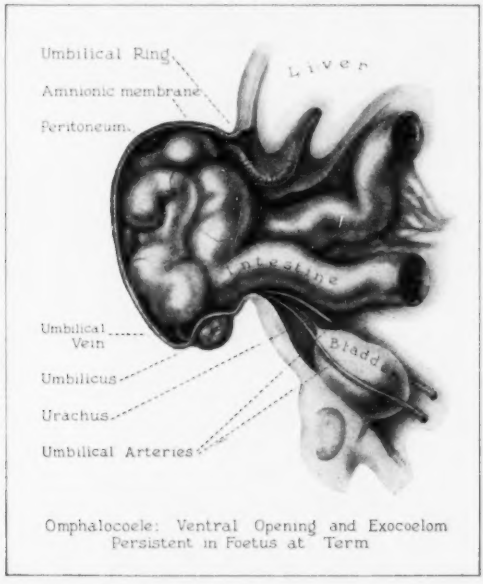


Fig. 4.—Ventral opening and exocelom persistent in fetus at term.

amniotic membrane [4] (fig. 4). This lesion presents a formidable problem to the surgeon. It has been emphasized that prognosis is determined largely by the size of the defect in the abdominal wall. We agree that this is true, especially if one attempts to replace abdominal viscera into the peritoneal cavity and primary layer closure. The mortality has been high because the abdominal viscera have been outside of the general peritoneal cavity during intrauterine life and the peritoneal cavity at

4. Ferguson, J. A.: Omphalocele, Persistent Omphalomesenteric Duct and Meckel's Diverticulum, Univ. Hosp. Bull., Ann Arbor, Mich. **14**:47, 1948.

the time of birth is too small to contain them. Death from attempts at primary closure in layers has been due to tension created within the abdomen, with subsequent respiratory and circulatory failure in twenty-four to forty-eight hours postoperatvely. To reduce the mortality in this group, two stage closure of the defect is of paramount importance.

In the group of 4 patients operated on for true omphalocele, liver was present in the sac in addition to loops of bowel. It has been stated by Ladd and Gross [2] that the presence of liver in the sac usually means

*Data on Patients with Hernia into Umbilical Cord and Omphalocele*

| Case | Sex | Weight Lb. Oz. | Hours Elapsed Before Operation | Abdominal Defect: Diameter | Abdominal Defect: Contents of Sac | Operation | Additional Defects | End Result |
|---|---|---|---|---|---|---|---|---|
| **Hernia Into Umbilical Cord** | | | | | | | | |
| 1 | M | 8 10 | 2 | 4 cm. | Small bowel | Excision, layer closure | Ruptured sac, evisceration | Good |
| 2 | F | 8 9 | 2 | 3.5 cm. | Small bowel | Excision, layer closure | None | Good |
| 3 | F | 7 10 | 4 | 4 cm. | Small bowel | Excision of sac and Meckel's diverticulum; ileoileoanastomosis | Patent ductus; Meckel's diverticulum; atresia | Died |
| **Omphalocele** | | | | | | | | |
| 4 | F | 8 | 3 | 8 cm. | Liver and small bowel | Excision, first stage closure | Absence of ligaments of liver | Good, awaiting second stage |
| 5 | M | 8 3 | 8 | 5 cm. | Liver and small bowel | Excision, first stage closure | Omphalomesenteric duct; congenital absence of left radius of second and third digits; facial paralysis | Good, awaiting second stage |
| 6* | M | 6 10 | 8 | 7 cm. | Liver, small bowel and stomach | Excision, first stage closure | None | Good * |
| 7 | M | 4 1 | 5 | 8 cm. | Liver, small bowel, stomach and large bowel | Closure impossible | Meckel's diverticulum; atresia; premature, 8 mo. | Died |

* Second stage layer closure was done at the age of 22 months; the result was satisfactory.

a poor prognosis. Of 8 of their patients who had some part of the liver in the sac, 6 died. Three of the 4 patents in our series who had liver in the sac recovered. It seems to us that the size of the defect as compared to the size and weight of the infant, in addition to prematurity, are factors which may play a prominent role in the prognosis. Also, the judgment exercised as to whether a one or a delayed two stage closure should be used in closing these large defects of the abdominal wall plays an outstanding role in influencing the prognosis.

The one death in this group (case 7) was that of a premature infant, weight 4 pounds 1 ounce (1.8 Kg.), with a defect measuring 8 cm. in diameter. The sac contained all the small bowel, colon, stomach and liver. In addition, there were a Meckel diverticulum

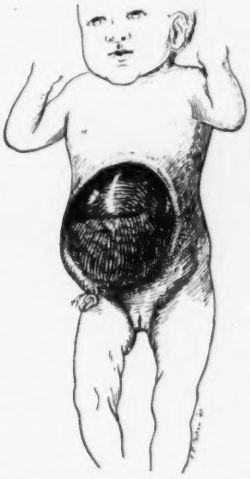

Fig. 5 (case 4).—Drawing of defect at birth. The sac contained small bowel and all the liver.

Fig. 6 (case 4).—Photograph of patient three months after primary stage closure showing residual defect in supraumbilical portion of abdomen.

and atresia of the small bowel. After resection of the amniotic sac and ligation of the umbilical vessels, the skin and subcutaneous tissues were widely undercut, but even after this procedure it was impossible to obtain an approximation of the skin over the herniated viscera.

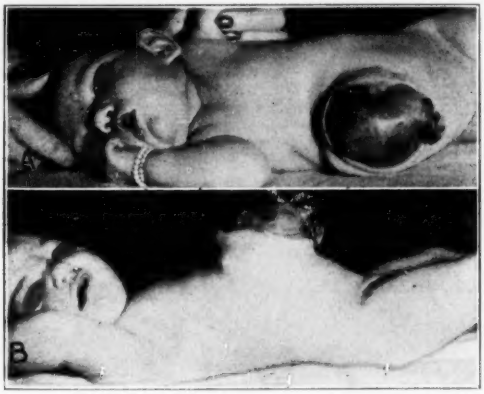

Fig. 7 (case 5).—*A*, photograph taken preoperatively showing a large defect of the abdominal wall, the sac containing nearly all the liver and small bowel. *B*, lateral view of same patient preoperatively. Note that the defect is limited to the umbilical and supraumbilical portions of the abdominal wall.

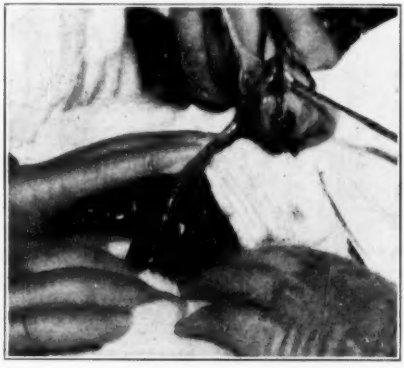

Fig. 8 (case 5).—Photograph taken at time of operation showing persistent omphalomesenteric duct.

In case 4, in addition to the large defect containing the liver and small bowel, it was noted at operation that there was a deficiency in the ligamentous support of the liver (absence of coronary and teres

ligaments, fig. 5). The round ligament was, therefore, anchored under the costal margin, and the right lobe of the liver was sutured to the peritoneum laterally for support. The convalescence was uneventful

Fig. 9 (case 5).—Photograph taken four months postoperatively showing residual hernia after primary stage operation.

Fig. 10 (case 6).—Preoperative photograph showing large abdominal defect which extends from the umbilical opening to the xiphoid process. The sac contained stomach, liver and small bowel.

(fig. 6). In case 5, in addition to liver and small bowel being present in the sac (fig. 7), there was also a persistent omphalomesenteric duct (fig. 8). The amniotic sac was excised after ligation of the umbilical

vessels. The opening in the ileum with which the omphalomesenteric duct communicated was closed in the transverse direction. The convalescence was uneventful (fig. 9). The closure of the defect in these 2 patients was accomplished by using only skin and subcutaneous tissue. The infants are now 19 and 15 months old respectively and ready for the second stage layer closure of the residual defect of the abdominal wall.

Case 6 presented the largest defect not only in diameter but in length (fig. 10). Not only the large defect but also the wide separation of the recti muscles and fascia can be seen in the figure. The same pro-

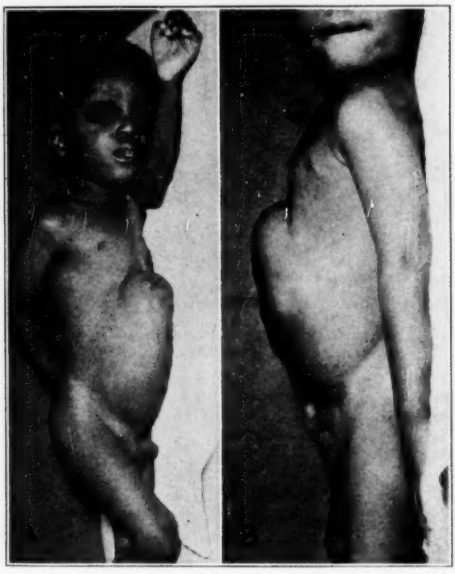

Fig. 11 (case 6).—*A*, photograph taken at an oblique angle showing the large hernia previous to the second stage closure at age 22 months. *B*, lateral view of the same patient.

cedure was carried out as in the 2 previous cases (skin closure) as a first stage operation. Subsequently, this patient was operated on at the age of 22 months, at which time the second stage closure was accomplished in layers with a satisfactory result (figs. 11, 12 and 13).

In a recent publication Gross [5] has made a contribution to the method of handling omphaloceles of this type. The essential feature

5. Gross, R. E.: New Method for Surgical Treatment of Large Omphalocele, Surgery **24**:277, 1948.

of his report is that the amniotic sac is not opened at the primary operation but is inverted, and after the skin margins are freed they are approximated over the amniotic sac as a first stage procedure. The purpose of this improvement in technic is to prevent adhesions of the

Fig. 12.—Photograph of the same patient ten days postoperatively, showing primary healing of wound, with a firm abdominal wall.

Fig. 13.—Lateral view of the same patient after the second stage layer closure.

abdominal viscera to the subcutaneous tissue and to provide a stronger wall than was provided by only skin and subcutaneous tissue. Gross has also recommended postponing the second stage for some months (six to twelve) to allow the abdominal wall to develop so that the abdominal viscera can be replaced in the peritoneal cavity and the layer closure of the wound accomplished with no tension. It seems

that the benefits of the method described by Gross of inverting the amniotic sac without opening it are outweighed by one significant objection. That is that other intraperitoneal congenital anomalies will be overlooked at the time of operation. To substantiate further this objection, attention is called to the fact that in this series of 4 patients with omphalocele which we are reporting there were four additional intraperitoneal anomalies.

## SUMMARY AND CONCLUSIONS

1. Three patients with hernia into the umbilical cord and 4 patients with omphalocele who were operated on within eight hours after delivery have been described. Recovery occurred in 5, the 2 deaths being in infants who had other congenital abnormalities which contributed to their deaths. All these patients have been operated on within the past two and one-half years.

2. Heredity has not been reported as a factor in the incidence of these anomalies. It is to be noted in this series that 2 patients (cases 1 and 2) were brother and sister. There was an interval of two years between their births, and both showed a similar congenital umbilical anomaly at birth, namely, a hernia into the umbilical cord.

3. Omphalocele or amniocele is a herniation of abdominal viscera through a defect which includes not only the umbilical ring but also the supraumbilical portion of the abdominal wall, with wide separation of the recti muscles and fascia and the sac covered by peritoneum and amniotic membrane, and is differentiated from hernia into the umbilical cord.

4. The time of origin of omphalocele is in the third week of embryologic life, whereas hernia into the umbilical cord occurs in the eighth to tenth week.

5. Early operation and the extent of the surgical procedure will be dictated by (*a*) the condition of the patient, (*b*) viscera in the sac, (*c*) coexistent anomalies and (*d*) the size of the defect.

6. The secondary layer closure of the omphalocele is postponed until one is able to reduce completely the abdominal viscera contained in the bulge of the abdominal wall subsequent to the first stage skin closure. This period will vary from six to eighteen months depending on the size of the defect and the growth of the abdominal wall structures.

7. The use of primary skin closure and delayed secondary layer repair of these large defects of the abdominal wall will reduce the high mortality and provide a method for obtaining a satisfactory anatomic result.

## DISCUSSION

Dr. C. W. McLaughlin, Omaha: I should like to report briefly an unusually large omphalocele which presented a problem in therapy. The child, a twin, was seen on the fifth day of life. Its weight was 4 pounds (1-8 Kg.). The abdominal defect which presented was 10 cm. in its transverse diameter and approximately 12 cm. in its vertical diameter. The opaque covering of the omphalocele showed early necrosis, particularly about the cord. The child was dehydrated, and after suitable preparation an effort was made to return the content of the sac to the abdominal cavity. The sac was seen to contain practically the entire liver and bowel, the abdominal cavity being very immature. When the liver was returned to the abdomen, there was no room for the bowel. Accordingly, the bowel was placed within the peritoneal cavity and approximately two thirds of the liver could be replaced within the abdomen, the remaining third protruding outside. Closure of the abdominal muscles and skin was out of the question, and the skin was tacked to the capsule of the liver, which was actually a portion of the omphalocele sac. A dressing using flamed adhesive tape was then applied over the liver to exert gradual pressure. The child did remarkably well and began to gain in weight and strength, and three weeks after operation was progressing satisfactorily. Twenty-six days after operation, without notice, the child suddenly became cyanotic, with irregular respirations, and succumbed within a period of approximately twelve hours. Autopsy showed healed peritonitis and atelectasis at the base of the left lung, with questionable pneumonia. The heart was in a transverse position but showed no congenital lesion. The postmortem diagnosis was immaturity and atelectasis with possible pneumonia, no other cause for death being found.

This case is presented for the reason that the method used may have some inherent advantage in instances in which exteriorized viscera cannot be returned to the abdomen.

Dr. Grover C. Penberthy, Detroit: This paper brings to our attention an important congenital condition which must be dealt with, as Dr. Benson has said, in the first few hours of life. In some cases obstetricians who see these conditions perhaps are of the opinion that they are inoperable. It does appear sometimes a little discouraging to see this tremendous omphalocele, and one wonders at the time if the closure can be accomplished.

In the differentiation between hernia into the umbilical cord and omphalocele it is apparent that the hernia into the umbilical cord must be handled and can be handled early, whereas the omphalocele can be closed by a two stage type of procedure.

The work of Dr. Gross, as mentioned, is constructive, but we are of the opinion that other anomalies will be overlooked. Yesterday Dr. Potts emphasized the importance of considering more than one congenital anomaly when one is dealing with what appears to be just one. Therefore, as Dr. Benson emphasized, we think this amniotic sac should be resected and the abdominal contents explored to see if other anomalies are present, as in the case described with an atresia of the ileum in addition to the omphalocele.

I am sure we are going to see more and more of these cases. Why I am unable to state. The cases all have been observed within the last two and a half years, and it is unusual even to see an occasional omphalocele. It will be interesting for Dr. Benson to bring up this type of case at some future meeting, and it also will be interesting to us to have any of you who have had occasion to deal with these omphaloceles give us information regarding your experience.

Dr. Jacob K. Berman, Indianapolis: I have been interested in Dr. Benson's excellent presentation. It has been my fortune to see many congenital anomalies in the newborn. In about one fourth of the cases they are multiple. Perhaps this figure would be much higher if we include minor defects which are not always apparent. In our experience multiple anomalies are less apt to occur in association with malformations of the foregut than with malformation of the midgut or hindgut. It has been my observation in congenital atresia of the esophagus, for example, that there is less likely to be associated anomalies. The same thing is true of congenital atresia of the biliary duct system, the stomach or the duodenum.

With regard to the specific problem at issue this morning, what I have to say is simply fortuitous, because Dr. Benson has covered the subject extremely well. The fifth to the ninth week of intrauterine life is a precarious time in our existence when almost the entire midgut lies outside of the abdominal cavity.

I agree with Dr. Benson and Dr. Penberthy that in association with omphalocele one is apt to see multiple anomalies, and I wish to report 2 cases which I have taken care of within recent months. One of the babies left the hospital just before I came to this meeting. These two cases are unusual because in 1 the transverse mesocolon was attached to the superior margin of the omphalocele. You will remember that the foregut gives rise to the alimentary canal from the mouth down to the duodenal papilla and is supplied by the celiac axis; its function is digestion. The midgut forms the canal from the duodenal papilla to the middle of the transverse colon and is supplied by the superior mesenteric artery; its function is absorption. The hindgut may be described as that portion of the bowel from the middle of the transverse colon to the anus, and it is supplied by the inferior mesenteric artery; its function is excretion.

We are dealing here with an anomaly of the midgut, and the transverse mesocolon in this case was densely adherent to the superior portion of the sac. In dissecting this loose one must be extremely careful in order to avoid injury to the middle colic artery, which constitutes the blood supply of the transverse colon. Furthermore, by being attached to the superior margin of the sac, the midgut cannot rotate in its normal direction, and therefore in 1 of these cases the ascending colon and cecum were on the left side of the abdomen; the ileum entered the cecum from right to left, and there was an associated Meckel's diverticulum and a patent urachus.

In the other there were three atresias of the terminal end of the ileum, which required resection and anastomosis between the ileum and the ascending colon. Fortunately the children did recover. In the case of a large omphalocele, it is better not to open the amniotic-peritoneal sac in search for associated defects. Instead, the skin should be widely mobilized as described and brought together, leaving the sac in situ.

Dr. George B. Packard, Denver: Dr. Benson and Dr. Penberthy have covered the subject thoroughly, and I particularly agree that the urgency of these operations is vital. I should like to mention 1 case as an example of a complication or at least an additional hazard in omphalocele. As omphalocele represents an arrest at the first stage of rotation, there may be anomalies of the intestinal attachment to cause trouble even after reduction of the contents and repair of the omphalocele.

A baby of about 6 pounds (2.7 Kg.) was born with a rather large protrusion, not covered with skin, which was repaired within a few hours of birth at a general hospital. The baby did fairly well at first but began to vomit at the age of about 1 week. In spite of feeding regulation, she continued to vomit no matter

what the formula or amount or method of feeding. Roentgenograms with barium showed no positive obstruction but a delay of the barium in the stomach and duodenum, with the cecum in the right upper quadrant.

Because of steady loss of weight and poor nutrition at the age of three weeks, the baby, now weighing 4 pounds 14 ounces (2.1 Kg.), was operated on. The findings were a dilated duodenum and attachment of the cecum at the duodenojejunal angle, resulting in partial obstruction. The cecum was freed from the duodenum and from all attachments to the right of the duodenum and placed in the left upper quadrant, thus allowing direct emptying of the duodenum into the jejunum and farther along the entrance of the ileum into the cecum from the right.

The baby has had a stormy course but is slowly gaining, holds most of its feedings and should now, at 6 weeks, get on well.

According to general belief, the small intestine outside the body cavity of the 8 week fetus returns first into the abdomen and is followed later by the colon and cecum. The fact remains that in this case the small intestine was still in the omphalocele, and after its return cecal attachments caused obstruction at the duodenojejunal junction—the typical point for obstruction and volvulus in second stage errors. I present this case, not to suggest any changes from the presented method of treatment, but to add that other intestinal defects may also exist and require surgical attention.

This roentgenogram shows the dilated duodenum and the jejunum, which has an obstruction between the duodenum and jejunum.

Dr. Edwin M. Miller, Chicago: The important points in the treatment of omphalocele in the newborn have been clearly brought out by Dr. Benson and Dr. Penberthy. The necessity for early operation is, of course, obvious, but I believe there is room for disagreement about the wisdom of opening the cellophane-like covering of peritoneum and of making an exploration for other possible anomalies, as they have suggested. True enough, several errors in development sometimes do occur together, but I would much prefer to take my chances on there being no other anomaly present and accomplish successfully the main, immediate objective, and that involves undercutting widely separated margins of the skin and bringing them together over the intact unfolded peritoneum. This point is well illustrated by these few colored slides of an infant girl on whom I operated in 1933 a few hours after birth. The future link, as in all these cases, was under some tension, the stitches gradually gave way and the granulating surface this produced slowly became covered by a rough, thick epithelium. It is well to remember that there need be no hurry about performing the second operation. In this case we allowed four years to elapse, and during that period the child wore a snug abdominal binder which effectively prevented any bulging in this region, so that in 1937 it was an easy matter to make an imbrication of the available tissue layers, after excision of the rough redundant skin, and thus secure a result which at this time (fifteen years after the birth) is entirely satisfactory.

Dr. Clifford D. Benson, Detroit: I have nothing further to add. I wish to thank the various discussers for the points they have brought out.

# THUMB TRACTION TECHNIC FOR REDUCTION OF COLLES' FRACTURE

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UP UNTIL the late 1920's the principles of treatment of Colles' fracture centered about forceful manual manipulation followed by immobilization in volar flexion and ulnar deviation with a padded plaster cast. Longitudinal traction, though recognized as of varying importance, played a comparatively minor role in the reduction. With the advent of Böhler's technic in 1929,[1] involving strong longitudinal traction of thumb and fingers against the fixed and flexed upper arm, came a marked change in the principles of treatment. By this method, hyperextension to break up impaction was eliminated and manual molding could be reduced to a minimum. We feel that strong traction in the longitudinal axis of the radius is an adequate means of overcoming radial impaction and dorsal displacement, though a certain amount of molding may be necessary to complete the reduction. By the use of the unpadded plaster cast, extreme volar flexion and ulnar deviation are unnecessary to maintain reduction of fragments.

After the acceptance of Böhler's principles by many surgeons, numerous devices were invented for putting them into effect. The original technic of the exertion of manual traction on the thumb and fingers by an assistant after both the patient's and the assistant's hands were coated with mastisol® (a solution of mastic) or benzoin entailed several disadvantages. Constant and unaltered traction was difficult to maintain and depended largely on the strength and steadiness of the assistant. A solution to this problem was reached when Caldwell, in 1931, ingeniously brought forth the "finger traps."[2] By applying these wire traps to thumb and fingers, fixed traction could be maintained without the aid of an assistant and without endangering the circulation to the fingers.

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Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 4, 1948.

1. Böhler, L.: The Treatment of Fractures, translated from the German, Baltimore, William Wood & Company, 1936.

2. Caldwell, J. A.: Device for Making Traction on Fingers, J. A. M. A. **96**:1226 (April 11) 1931.

In first applying this technic, the authors and their associates used the thumb and all four fingers for traction. Gradually, however, it was found that the use of the thumb, index, middle and ring fingers was sufficient. Then evolved the use of just thumb and index and middle finger, with less pull on the fingers, and finally the use of the thumb alone. This gradual evolution of procedure has occupied the last sixteen years and has entailed the trial of various modifications of Böhler's technic. The final method, which we shall now describe, has been used successfully for the past eight years in a gradually increasing percentage of cases and with gradually increasing satisfaction.

## TECHNIC

Local injection of 10 to 20 cc. of 1 per cent procaine hydrochloride into the dorsal aspect of the fracture hematoma is the anesthesia of choice.

Fig. 1.—The cast has been applied, but the traction is still on. Note how the x-ray machine can be brought close in any direction. The loop of rope which comes out at the top and bottom is merely a guide for splitting the cast on the ulnar side.

With the patient lying flat on the orthopedic table, the arm is abducted to 90 degrees and fixed countertraction applied by means of a canvas sling over a felt pad on the upper part of the arm. A 6 cm. length of stockinet is applied to the upper part of the forearm to prevent trauma to the skin from the upper end of the cast. After the application of a single finger trap to the thumb, the elbow is flexed to 90 degrees with the forearm vertical. The cord from the finger trap is placed through a slot in the end of an overhead cross bar. This bar extends parallel to and approximately 3 feet (91 cm.) above the upper part of the arm. By gradual turning of the overhead cross bar the cord to the finger trap is tightened and traction to any desired amount is exerted on the thumb. If desired, a spring scale can be incorporated between

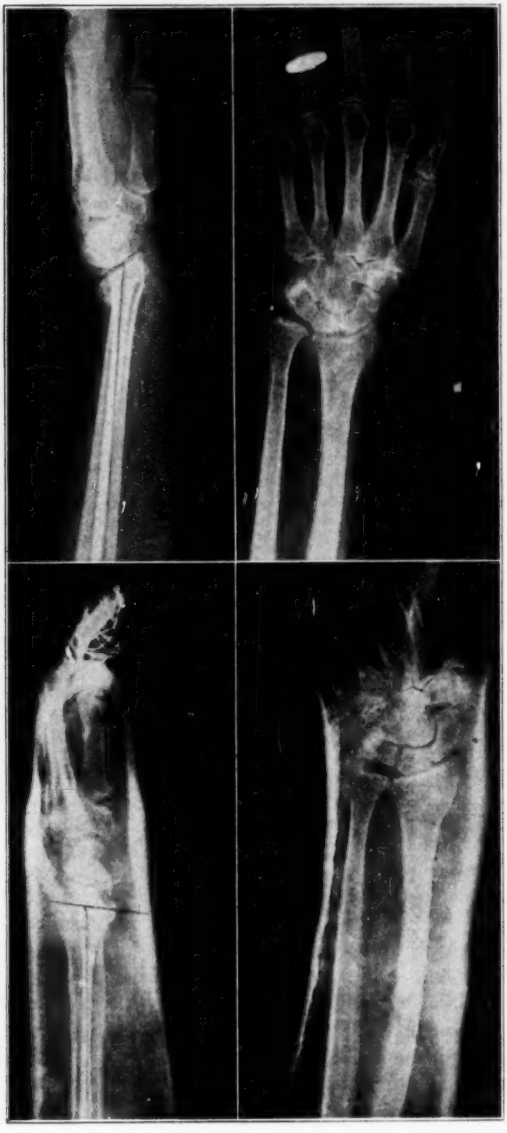

Fig. 2.—Roentgenograms in a typical case. Above, before reduction; below, after the cast has been applied, showing how straight traction on the thumb only has corrected the deformity and given a reasonable amount of ulner deviation.

the finger trap and its cord. It can be seen that in this manner traction is exerted directly in the longitudinal axis of the radius, with a certain amount of ulnar deviation necessarily resulting. After five to fifteen minutes of traction, fluoroscopic examination is made, and if reduction is not complete, gentle manipulation and molding usually effect a satisfactory reduction.

With the use of a single roll of 5 inch (12.7 cm.) plaster bandage for the entire cast, a longitudinal splint is first made with approximately half the bandage and placed on the radial aspect of the forearm. A narrow strip of sheet wadding is next applied to the ulnar side of the forearm, and over it is placed a length of rope somewhat longer than the cast.[3] A small piece of sheet wadding is placed between the thumb and forefinger. With the remainder of the plaster roll a skin-tight circular cast is applied from the horizontal palmar crease to approximately 9 cm. distal to the olecranon. Several layers of plaster are brought between the thumb and index finger to hold the first metacarpal bone in position. When the plaster has set, a split is made in the cast along the ulnar side, through which the length of rope is removed, thus eliminating the possibility of undue constriction. Finally, the cast is wrapped with several layers of wet roller bandage and the arm released from traction. Anteroposterior and lateral roentgenograms are made for permanent record. The patient is instructed to begin active exercise of the fingers, elbow and, particularly, the shoulder at once. Check-up roentgenograms may be made after one week, and the cast is removed after seven to eight weeks.

### ADVANTAGES OF REDUCTION METHOD

1. In a large percentage of cases, traction on the thumb only achieves satisfactory reduction.

2. Trauma to the soft tissues of the wrist is reduced to a minimum.

3. The entire procedure can be done by one person, with the aid of an x-ray technician.

4. The wrist is readily accessible to the portable x-ray machine because of minimal obstruction from apparatus and assistants and constant immobilization of the forearm.

5. The vertical position of the forearm eliminates the greater or lesser amount of displacement which might result from gravity if the traction were exerted horizontally.

6. Application of the cast is facilitated by the immobilization (mechanical) of the forearm.

ADVANTAGES OF METHOD OF CAST APPLICATION

1. The possibility of undue constriction of the forearm is eliminated. (Patient can cut roller bandage over split in cast to release pressure if necessary.)

2. Application is quick and simple.

3. A minimum of material is necessary.

4. The cast is thick on the radial surface, where strength is most needed, and thin on the ulnar surface.

5. The only limitation of motion is at the wrist, which eliminates the possibility of a stiffened hand, elbow and shoulder.

6. The cast is light and not cumbersome.

## DISCUSSION

Dr. Ralph G. Carothers, Cincinnati: The reason we felt called on to write this paper is that in some clinics we have seen demonstrated methods of reducing Colles' fracture which required a good deal of assistance. In other words, it took several persons to handle the patient. Our second reason was that it has always hurt our feelings to believe that a thing had to be made worse before it could be made better. We are referring, of course, to the severe dorsal flexion that is carried out by some surgeons with the idea of disimpacting the fragments. The slides show that with thumb traction only we have been able to disimpact the fragments and line them up nicely, and we have been able to do this without the assistance of any second person and get the cast on easily.

Dr. Kellogg Speed, Chicago: Dr. Carothers, in his effort to improve fracture treatment, has again exhibited his thoughtful work. You must admit that this method is efficacious. It depends, certainly, on the integrity of the radiocarpal, the carpal and the metacarpal-carpal ligaments. Were they not intact, this method would fail because there would be no method of traction on the lower or distal end of the radius.

He has thus, by traction, complied with the criteria of reduction, namely, the reduction of the silver fork deformity, the restoration of the relationship of the styloid processes of the two bones and finally the restoration of the looking forward and downward angle of the radiocarpal joint.

I have used this method in the past only in cases of old or ancient fractures with deformity, in which I had to do an osteotomy on the radius to loosen it up and to try to get it back into better position. Certainly it works well in such cases, combined with skeletal traction through the thumb to a banjo splint. I have never had to use it in a recent or fresh case, but I may in the future.

Dr. Foster J. Boyd Jr., Indianapolis: I have nothing to add; I merely wish to thank Dr. Speed for his constructive discussion.

# CLASSIFICATION AND TREATMENT OF TROCHANTERIC FRACTURES

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THE PURPOSE of this paper is to present the data obtained from the study of 300 trochanteric fractures of the femur treated by the staff of the Campbell Clinic. The results obtained by internal fixation are compared with those following nonoperative methods. A classification is given based on prognosis and the difficulty of securing and maintaining reduction. The number of cases was arbitrarily limited to 300 to facilitate calculation of data. These were as nearly consecutive as possible, consistent with the availability of roentgenograms and completeness of records. All were private patients and most were treated at the Campbell Clinic, since a complete series of roentgenograms was not always preserved at other hospitals. Avulsion fractures of the greater or lesser trochanter were excluded.

A number of classifications of trochanteric fractures are recorded in the literature. These have generally been based on the anatomic site of the fractures. Stuck [1] (using Boehler's classification), Moore,[2] Briggs and Keats [3] and others classified trochanteric fractures primarily from an anatomic standpoint. Key's [4] and Myron Henry's [5] classifications were devised as guides to the use of various types of internal fixation.

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Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 4, 1948.

From the Campbell Clinic and the Department of Surgery, University of Tennessee, Memphis, Tenn.

1. Stuck, W. G.: The Treatment of Intertrochanteric Fractures of the Femur, Surgery **15**:276 (Feb.) 1944.

2. Moore, J. R.: Fractures of the Upper End of the Femur Including Fracture Dislocation at the Hip Joint, Am. J. Surg. **44**:117 (April) 1939.

3. Briggs, H., and Keats, S.: Management of Intertrochanteric Fractures of the Femur by Skeletal Traction with the Beaded Kirschner Wire, Am. J. Surg. **71**:788 (June) 1946.

4. Key, J. A.: Internal Fixation of Trochanteric Fractures of the Femur, Surgery **6**:13 (July) 1939.

5. Henry, M. O.: Intertrochanteric Fractures, Minnesota Med. **26**:690 (Aug.) 1943.

In the study of this series, the cases were grouped according to the relative ease or difficulty of securing and maintaining reduction; this, we feel, provides information of value in planning the treatment and estimating the prognosis. Four types were designated.

Type I designates fractures showing a more or less linear break extending along the general direction of the intertrochanteric line from greater to lesser trochanter (fig. 1). In this group reduction is usually simple and maintained with the least difficulty.

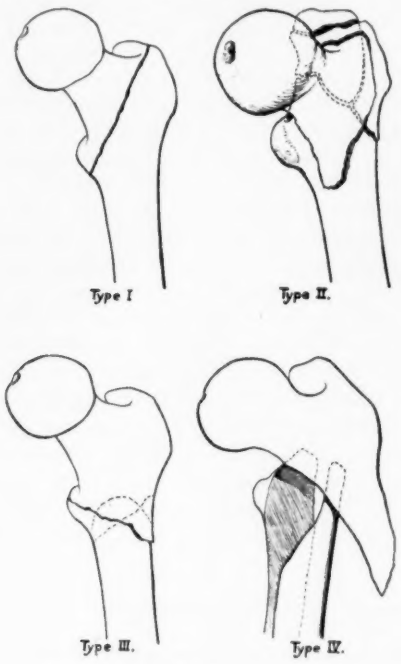


Fig. 1.—Types of trochanteric fracture.

Type II designates fractures which are comminuted, with the main line of fracture being along the intertrochanteric line but with multiple breaks occurring in the cortex (fig. 1). Here reduction is more difficult. In this type degrees of comminution vary from slight to the extreme. One deceptive form of type II fracture is that which on an anteroposterior roentgenogram appears to be a linear intertrochanteric fracture, or type I, but in the lateral view of the femoral neck and trochanter reveals an additional fracture in the coronal plane.

Type III designates fractures which are essentially subtrochanteric, with at least one fracture line passing across the upper end of the shaft just below or in the region of the lesser trochanter (fig. 1). Various degrees of comminution may be associated with this type. The features seen in either type I or type II may be present in addition to the subtrochanteric fracture. Type III fractures are generally much more difficult to reduce and to maintain in reduction than either of the first two types.

Type IV designates comminuted fractures which extend through the trochanteric region and usually on into the shaft, with fracture

TABLE 1.—*Trochanteric Fractures of the Femur*

| Type | Number of Cases | Percentage |
|---|---|---|
| I | 88 | 29.3 |
| II | 111 | 37.0 |
| III | 80 | 26.7 |
| IV | 21 | 7.0 |
| Total | 300 | 100.0 |

TABLE 2.—*Mortality of Trochanteric Fractures of the Femur*

| Age | Number of Cases | Deaths | |
|---|---|---|---|
| | | Number | Percentage |
| Under 59 | 62 | 0 | 0 |
| 60 to 69 | 48 | 4 | 8.33 |
| 70 to 79 | 118 | 19 | 16.1 |
| 80 to 89 | 60 | 23 | 38.3 |
| 90 to 96 | 9 | 7 | 77.8 |
| Exact age unknown | 3 | 1 | 33.3 |
| Total | 300 | 54 | 18.0 |

lines in at least two planes. In the event open reduction and internal fixation are employed, these fractures require two plane fixation.

The frequency of the four types is noted in table 1. Fortunately the most difficult fractures to manage, types III and IV, constituted only 33.7 per cent of the entire series.

Ninety and seven-tenths per cent of the patients were over 50 years of age, with the average age for the series being 69.7 years. The mean age (representing 39.7 per cent of all the patients) was 70 to 79 years of age. A marked sex difference was seen; 226, or 75.8 per cent, of the patients were females and 74, or 24.2 per cent, were males. None of the patients had more than one trochanteric fracture, but patients were included in the series who had a fracture of the femoral neck on one side and a trochanteric fracture on the other, not simultaneously.

Additional fractures were seen in 25, or 8.3 per cent, of the patients; sixteen of these were Colles' fractures and nine were other fractures.

The mortality rate was 18 per cent, 54 deaths in 300 cases. The mortality rate by decades is shown in table 2. As shown, no deaths occurred in patients under 60 years of age. The mortality rate increased with each decade to 77.8 per cent in the tenth decade. A breakdown of mortality following the four main types of treatment used is shown in table 3. It is of interest to note that although a greater proportion of patients die after internal fixation during the first month, 13.3 per cent

TABLE 3.—*Mortality in Types of Treatment of Trochanteric Fractures of the Hip*

| Type of Treatment | Number of Cases | Under 1 Mo. | Under 3 Mo. | After 3 Mo. | Percentage |
|---|---|---|---|---|---|
| None | 8 | 4 | 0 | 0 | 50 |
| Traction | 6 | 0 | 1 | 0 | 16.7 |
| Casts | 77 | 7 | 6 | 1 | 18.2 |
| Internal fixation | 209 | 28 | 6 | 1 | 16.7 |
| Total | 300 | 39 | 13 | 2 | 18.0 |

TABLE 4.—*Types of Treatment for Trochanteric Fractures of the Hip*

| Treatment | Number | Percentage |
|---|---|---|
| None | 8 | 2.8 |
| Traction | 6 | 2.0 |
| Casts | 77 | 25.7 |
| Nonoperative | 91 | 30.5 |
| Neufeld nail | 164 | 54.5 |
| Jewett nail | 28 | 9.3 |
| Other types of internal fixation | 17 | 5.7 |
| Operative | 209 | 69.5 |
| Total | 300 | 100.0 |

as compared with 9 per cent of those treated by casts, the total mortality rate, including deaths known to have occurred at least in the first three months after injury, showed a lower rate, 16.7 per cent in the operative group as compared with 18.2 per cent of those treated by casts.

The types of treatment used in these cases are shown in table 4. These data do not represent the present policy toward the treatment of trochanteric fractures. The nonoperative group, 30.5 per cent, largely represents the patients treated in the earlier years included in this study. At the present time the vast majority of patients are treated by operative methods. Since the Jewett nail has been used only during the past two and a half years, it is now being used in a larger percentage of patients than indicated in the table.

In the patients listed as having no treatment a Thomas splint with adhesive traction was applied to the involved leg, but no further measures were taken, generally because the patient's condition was too poor to warrant more aggressive treatment. Four of these patients died shortly after admission to the hospital, and 2 were carried home, with no follow-up information available. In 1 patient union occurred in three months, but with coxa vara deformity. The eighth patient, who had fallen on the hip of an amputated limb, was treated in bed for a month and then allowed up on crutches without wearing his prosthesis; the fracture united without deformity.

Six patients were treated by traction, 2 with skeletal traction and 4 with adhesive traction on Hodgen's splints. One died after three months in traction, 1 was "taken home to die" after seventy-six days, without follow-up, and in 4 the fracture united, with coxa vara in 2. This method was not favored because of the immobility of the patient in bed and the long period of hospitalization required.

Seventy-seven patients were treated in plaster of paris casts. Sixty-six of these were placed in body casts in which a Hoke well leg traction was incorporated, i. e., adhesive traction, beneath the cast on the affected leg, attached to a ratchet to maintain the traction. This method was considered the most satisfactory of the nonoperative procedures, as the patient could be turned over in bed. Also, if the patient's general condition permitted, hospital care would be shortened to a few weeks, provided proper nursing and medical care were available at home.

In the group treated by casts as a whole 14 died—a mortality rate of 18.2 per cent—which compares favorably with Key's report [4] of a 38 per cent mortality in 214 intertrochanteric fractures treated conservatively. Morris [6] reported a 44 per cent mortality rate in 16 consecutive cases of trochanteric fractures treated by nonoperative means. Harmon [7] reported a 39 per cent mortality in 164 cases, and Taylor and others [8] reported a 25.4 per cent mortality in 114 cases of fractures treated without operation. All the patients in this series were private patients, which had some bearing on the relatively low death rate, as adequate means were available for the proper care of a patient in a body cast. An incidence of coxa vara of 10 degrees or more was noted in 25, or 31.4 per cent, of this group. This developed in spite of closed reduction under anesthesia and after good position was demonstrated by postoperative roentgenograms made through the casts. Nonunion

6. Morris, H. D.: Trochanteric Fractures, South. M. J. **34**:571 (June) 1941.

7. Harmon, P. H.: The Fixation of Fractures of the Upper Femur and Hip with Threaded, Hexagon-Headed, Stainless-Steel Screws of Fixed Length, J. Bone & Joint Surg. **27**:128 (Jan.) 1945.

8. Taylor, G. M.; Neufeld, A. J., and Janzen, J.: Internal Fixation for Intertrochanteric Fractures, J. Bone & Joint Surg. **26**:707 (Oct.) 1944.

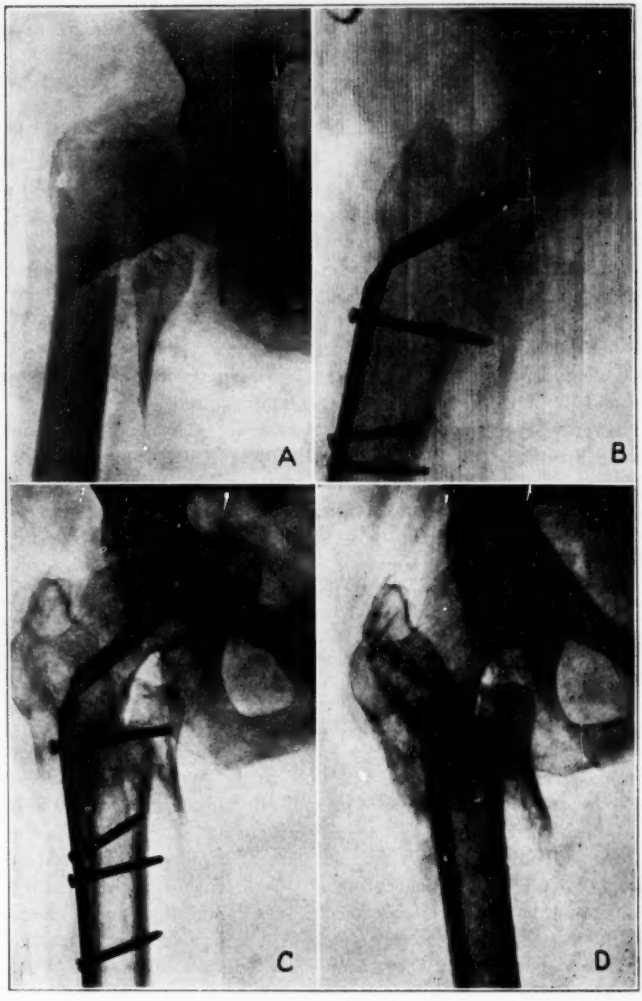


Fig. 2.—*A*, a comminuted type II fracture which was converted to a type III fracture at the time of operation. *B*, roentgenogram taken in the operating room after the operation. Note that the end of the nail comes within a centimeter of the articular surface. A shorter nail would have been preferable. *C*, result following medial migration of the distal fragments, with penetration of the acetabulum by the Neufeld nail. *D*, result seven months after the operation; the Neufeld nail has been removed. There is bony union, with a good functioning hip.

occurred in 1 patient treated by Hoke well leg traction. Here reduction was demonstrated to be adequate by postoperative roentgenograms except for moderate angulation in the lateral view. At the end of two and a half months there was no sign of union, and the cast was removed and the patient kept in bed. Six months after the first reduction a bone

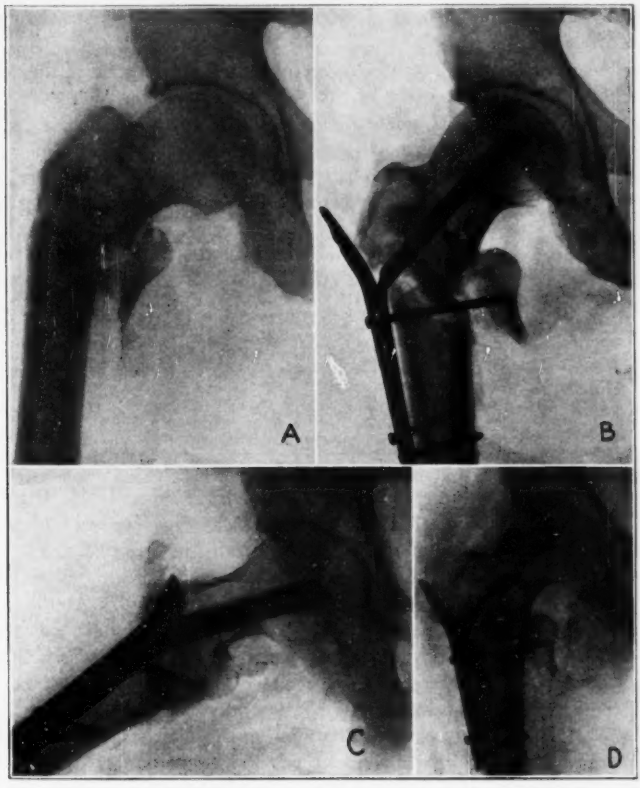


Fig. 3.—*A*, comminuted type III trochanteric fracture. *B*, position of the fragments and the internal fixation following the use of a Neufeld nail and additional plate to prevent medial migration of the distal fragment. *C* and *D*, appearance of the fracture and the internal fixation six months after the operation. The fracture has united in satisfactory position.

graft was done, and union was obtained. Another nonunion developed which required a subsequent bone graft, but this was not necessarily due to the method of treatment, as the patient, a wilful 27 year old man, took his cast off without permission and started full weight bearing at five and a half weeks.

Internal fixation was carried out in 209 patients, or 69.7 per cent, of the series. The Neufeld nail was used in 164 patients and other forms of internal fixation in the remaining 45.

In 4 cases of this series, type I fracture in 1 case and type II in 3 cases, the fractures were converted to type III at the time of operation. The lateral cortex was shattered either by drilling the hole for the nail or at the time the nail was inserted, which produced a subtrochanteric fracture.

In subtrochanteric (type III) fractures medial migration of the distal fragment may occur because of the pull of the adductor muscles. This is especially true if the angle of the Neufeld or Jewett nail is at the same level as the subtrochanteric fracture. Since the plate element of these nails is attached to the shaft of the femur, any medial migration of the shaft fragment forces the proximal portion of the nail deeper into

TABLE 5.—*Loss of Position in Fractures Treated by Internal Fixation*

| Type | Number | Coxa Vara | Medial Migration | Type Converted to III | Non-union |
|---|---|---|---|---|---|
| I | 62 | 4 | .. | 1 | 1 |
| II | 76 | 7 | 1 | 3 | .. |
| III | 54 | 9 | 9 | .. | 3 |
| IV | 17 | 2 | .. | .. | .. |
| Total | 209 | 22 | 10 | 4 | 4 |

the head of the femur. The nail may be forced through the articular surface of the head of the femur and into the hip joint and in some cases through the floor of the acetabulum into the pelvis (fig. 2). To prevent this medial migration we have used additional internal fixation of several types. None has been completely successful. At the suggestion of Dr. Thomas A. Richardson, one of the fellowship men at the Clinic, a "T" or "Y" type of nail has been used. This is accomplished by superimposing a second plate over the vertical portion of the Neufeld nail which extends upward along the lateral surface of the trochanter (fig. 3). This prevents medial migration of the shaft fragment but does not prevent bending of the Neufeld nail and angulation at the fracture site. The Neufeld nail is ideal for type I and II fractures, but it should be made stronger for type III fractures.

Type III fractures are the most difficult to treat. A study of table 5 shows that coxa vara is more common in subtrochanteric fractures than in any other type. Medial migration of the distal fragment was seen in only one type II fracture and in no fractures of types I and IV, while this complication was seen in nine type III fractures. Nonunion is rare in trochanteric fractures. When it does occur it is usually seen in type III fractures. In the 209 patients who were treated by

operation, nonunion occurred in three type III fractures and in one type I fracture.

Eight Neufeld nails bent, and three broke. This weakness is one of the disadvantages of the Neufeld nail. On the other hand, its slight flexibility is an advantage in securing accurate apposition between the plate portion of the nail and the shaft of the femur. In 3 muscular persons in whom it was feared the nail would bend, two Neufeld nails were superimposed. No bending occurred in these patients.

In type IV fractures in which two plane fixation was necessary, reduction was accomplished and stainless steel screws were placed across the fracture line or lines from cortex to cortex before the blade plate was applied. In this series, supplementary internal fixation was used eleven times in addition to Neufeld nails.

Jewett nails were used in 28 cases. These have given satisfactory results, with no instances of breakage of the nail. In these cases, coxa

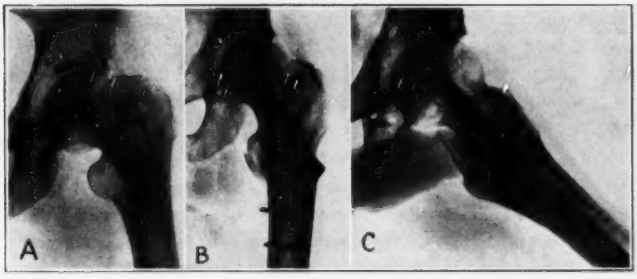


Fig. 4.—*A*, comminuted type II trochanteric fracture. *B* and *C*, result six months after insertion of the Jewett nail.

vara occurred in only 3.6 per cent of the cases, as compared with 9.7 per cent of cases in which Neufeld nailing was used. The Jewett nail is more difficult to insert, as the guide wire must be in the proper position while the Neufeld nail may be allowed to drift slightly from the guide wire in order to insure proper apposition of the plate to the side of the femoral shaft.

The Moore-Blount blade plate was used in 6 cases. Surprisingly, despite the apparent great strength of the nail, one broke at its angle.

One patient in this series had a complete posterior dislocation of the head of the femur with an associated trochanteric fracture. This patient was treated by open reduction of the dislocation and fixation of the fracture with Knowles pins followed by skeletal traction for sixty-four days. No loss of position occurred.

An analysis was made of the 209 cases in which internal fixation was used and of the results obtained in the different types. As might be predicted, type III fractures proved to offer the greatest incidence of

loss of position postoperatively. In all, there were 9 cases of medial migration of the distal fragment, 9 cases of coxa vara and 17 cases of protrusion of the nail through the head. All three conditions tended to occur simultaneously. Most of these occurred in type III fractures. These factors suggested the need for supplementary internal fixation in some type III fractures. All type III fractures do not require additional internal fixation. Some are stabilized by jagged or serrated fracture lines that prevent migration after accurate reduction. In others a solid bridge of bone between the portion of the nail in the head and neck of the femur and the subtrochanteric fracture will prevent medial migration of the distal fragment. Also, the type II fractures offer some difficulty in maintenance of reduction. In this group there were 7 cases of coxa vara and 1 of medial migration of the distal fragment.

In the series, some of the nails obviously were too long when first inserted, but it is believed that "overdrive," as described by Cleveland and others,[9] depends also on the type of fracture involved. Type III fractures offered the best opportunity for medial migration of the shaft and nail, permitting protrusion of the nail through the head. A low incidence of postoperative loss of position in the difficult type IV fractures was due to adequate fixation of the fragments at the time of operation.

## COMMENT

In a comparison of the results in the patients treated by internal fixation with those in patients treated by nonoperative measures, the mortality was no higher in the operative series. In hospitals where the nursing problem makes it difficult to give patients in body casts adequate care, the mortality would be much less in the patients treated by operation than in those treated by casts or in traction.

The patients treated by internal fixation are more comfortable. Adequate medical care, especially to prevent decubitus ulcers and postoperative pneumonia, is facilitated. The time in the hospital is reduced, which is a saving in hospital beds and lightens the financial strain on the patient and his family. Cleveland and others [9] have shown that senile psychosis is far more frequent in patients treated in body casts than in the patients treated by operation. At the present time, it is our policy to treat all patients that are not moribund by open reduction and internal fixation as soon as they can be hydrated and their general medical condition evaluated. In our experience the general condition of the patient can rarely be improved by delaying surgical treatment more than twelve to twenty-four hours. The patients' general condition usually improves after the operation, as they can be moved often and with little pain.

9. Cleveland, M.; Bosworth, D. M., and Thompson, F. R.: Intertrochanteric Fractures of the Femur: A Survey of Treatment in Traction and by Internal Fixation, J. Bone & Joint Surg. **29**:1049 (Oct.) 1947.

Trochanteric fractures usually unite; consequently, they have not been given the consideration in medical literature that has been devoted to fractures of the neck of the femur. Avascular necrosis of the head of the femur, seen so often after fractures of the neck of the femur, is not seen after trochanteric fractures. The only exception to this rule was in 1 case of fracture of the base of the neck of the femur associated with a comminuted trochanteric fracture. In other respects, trochanteric fractures are more serious than neck fractures. In our series [10] the average patient with a trochanteric fracture was older than the patients with fractures of the neck of the femur and the mortality has been about double. The operation required for internal fixation of a trochanteric fracture is more extensive than that for a fracture of the neck of the femur. We routinely give 500 cc. of whole blood at the time of operation. This is not necessary with fractures of the neck of the femur unless the general condition of the patient requires it.

The prognosis in type III subtrochanteric fractures is poorer than in the other three types. Coxa vara is more apt to occur. Nonunion, rare in trochanteric fractures, is most apt to be seen in this type. If the type III fractures are not well stabilized at the time of operation, medial migration of the distal fragment may occur. If this complication is likely, additional internal fixation is indicated.

SUMMARY

1. Three hundred cases of trochanteric fractures are reviewed.

2. There was a gross mortality rate of 18 per cent.

3. The fractures have been classified into four types and the prognosis given for each group.

4. The difficulties encountered in the subtrochanteric (type III) fractures are emphasized and a method to prevent medial migration of the distal fragment suggested.

5. Various forms of treatment are evaluated, with the conclusion that operative treatment and internal fixation is the treatment of choice.

## DISCUSSION

DR. DON H. O'DONOGHUE, Oklahoma City: This is a pertinent subject for some of us "bone setters." As you are all well aware, in the last few years there has been a drastic change in treatment of a fracture of the neck of the femur to the point where I think it is completely accepted that if a fracture of the neck of the femur will not survive surgical repair it will not survive so-called conservative treatment.

I believe the treatment should not be called conservative or operative but should be called nonsurgical or surgical, because in the great majority of instances the surgical treatment is the conservative treatment.

10. Boyd, H. B., and George, I. L.: Fractures of Hip: Results Following Treatment, J. A. M. A. **137**:1196-1199 (July 31) 1948.

I have heard Dr. Boyd talk on this subject before, and I know he was handicapped somewhat this morning from the standpoint of time. I think we should enlarge a little not on the technical factors, because they are not particularly important, but on the problem as a whole. What are the alternatives in the treatment of an intertrochanteric fracture? As a rule the intertrochanteric fracture occurs in a slightly older age group than does a fracture of the neck of the femur. These persons are extremely poor risks, no matter what you do.

The so-called conservative or, as I prefer to call it, the nonsurgical method entails one of two or three things: First, do nothing to the leg. Second, put it in a cast with various forms of fixed traction. Third, put it in so-called movable traction with Kirschner wires and weights. Any of those methods entails a long period in bed. That time in bed may range anywhere from twelve to twenty-four weeks. If you put a person in that age bracket to bed for that length of time you will make an invalid of him.

Dr. Boyd's figures on mortality are entirely misleading if you consider a patient's useful life rather than the fact that he is alive and breathing. Old persons put to bed for many weeks, or kept in the hospital for many weeks, become disoriented and mentally unbalanced; they have a great deal of difficulty in ever regaining that spark which keeps them alive and in active health.

I would like to second Dr. Boyd's comment that if the patient is not moribund on admission surgical treatment should be strongly considered. Almost uniformly we regret later not operating on patients because they are bad risks. If they are going to be operated on they should be operated on soon. That does not mean particularly as an emergency. You can take twelve, twenty-four or thirty-six hours to prepare them, if you wish. After that length of time you will lose ground unless there is some specific problem you can remedy.

Too often the medical consultant will say: "Let me build him up and get him in better shape." The result is that the patient gets in worse shape. I think that in another five or ten years the surgical treatment for intertrochanteric fractures will be just as much accepted as is the surgical treatment now for fractured neck of the femur.

DR. JAMES J. CALLAHAN, Oak Park, Ill.: About seven years ago we collected 100 cases of intertrochanteric fracture picked at random. Most of those cases were of two to ten years' duration. We were surprised at the end results. Naturally, in a county institution one cannot get the response of outpatients that one would like to have. We had an adequate response. In this number of cases we found that on return examination every patient had from ½ to 2 inches (1.27 to 5.08 cm.) of shortening. When they left the hospital their legs were of equal length. We had 1 case of nonunion.

The peculiar complaint of all those patients was not pain in the hip but pain in the back because of the shortening and the fact that the back could not accommodate this. The arthritic changes were present in the back.

These patients were all treated conservatively, or nonsurgically if you wish. It is our belief that patients with intertrochanteric fractures which are not comminuted, or, as in Dr. Boyd's classification, with type I fractures, should be operated on. We do not operate on comminuted fractures. I realize that this is a departure, but when you try to operate on these patients you have an eggshell to put your plate on, or screws or whatever type of internal fixation you wish to use, and frequently you will find that after putting in this internal fixation, if it is not protected adequately, it will break through or break off.

DR. KELLOGG SPEED, Chicago: I am a great admirer of Dr. Boyd, his clear thinking and the excellent way in which he expresses his thoughts. Also, as you all know, he works with Speed.

In the matter of the care of these fractures, in 1921 I reported a series of 120 cases without operative correction. Since then I have practically never used operative fixation for this type of fracture, for some of the reasons which Dr. Callahan has already stated or which have entered into the discussion. These persons are old, and their bones are soft, and the trauma of the injury, which does not so seriously affect the young active person, leads to serious fracture.

(Slide) The mechanism of the injury is a fall on the side and not a preliminary fracture or trip, as in fractures of the neck of the femur. There is a massive force applied on the thigh, with the body weight acting as the other factor to separate the intertrochanteric part of the femur.

(Slide) This opens up a large part of the femur, composed of porous or cancellous bone which has perhaps the best blood supply of any part of the whole femur; so you may expect, as already has been said, that a bony union will develop.

(Slide) The different types (and these are illustrated by me in 1921) shown are the same as those that Dr. Boyd has mentioned to you, without any attempt at too rigid classification. I do not believe you can put them all in closely bound bundles, but the slide shows the different types as then described.

(Slide) The worst types are these comminuted ones or the impacted ones, in which the sharp angle of the head fragment is shoved down into the cancellous bone of the trochanteric fragment.

(Slide) The most difficult ones are those in which there is gross overriding or shortening, generally in the neglected type.

For nonoperative treatment we use the Russell traction. This will pull down most of the fractures within twenty-four hours, especially if you put a box under the foot on the well side, a padded box such as a starch box, so that the patient can use his good leg for counterpressure. The Russell traction inevitably pulls down and abducts, and in most cases within twenty-four hours there is a reduction.

Eight weeks is all that any patient requires in bed, regardless of age. I disagree with Dr. O'Donoghue that some need twelve or twenty weeks. Eight weeks is all they need, and then they can be put in a chair and their progress stimulated in the ordinary way.

It seems to me that with the thinness of the outer wall of the femur and the dangers of operation, not in the hands of Dr. Boyd or of the men in the Campbell Clinic or of other surgeons present here but in the hands of the average physician, the implanting of complicated angle irons is far too great for them to attempt.

DR. F. WALTER CARRUTHERS, Little Rock, Ark.: I have had many opportunities in the past to see and observe intertrochanteric fractures. I feel that it is timely to emphasize, particularly to the patient, the difference between intertrochanteric fractures and capital fractures of the neck of the femur. No doubt many of you have the same experience as I with the referral of such a case. The attending physician many times says: "I am sending you a patient with fracture of the hip." They use this term when in reality it is an intertrochanteric fracture.

In my personal interviews with my patients who happened to be the victims of intertrochanteric fractures—usually seen in elderly women and occasionally in men—I refer to the intertrochanteric fracture as a fortunate fracture, in spite of the high mortality, as demonstrated by Dr. Boyd. It occurs in the older person. The patients themselves are interested in only one question: "Will my fracture unite, and will I be able to walk again?" In my answer, based on statistics, I assume full confidence of a union. This, I think, is a good answer psychologically.

Obviously, if the patient dies as a result of the particular type of fracture, nothing can be done. On the other hand, the assurance of the patient who survives that he can expect a union and be able to walk is a paramount conclusion in the case after all.

At this time I can recall nonunion in only one intertrochanteric fracture and that was a fracture involving pathologic changes in the bone. One should bear in mind from the beginning that one is dealing with an intertrochanteric fracture which is in reality a fracture of the shaft of the femur involving the trochanteric region. This certainly places it in a specific anatomic category, in direct contrast to a capital fracture only about 1 inch (2.5 cm.) away.

There are, obviously, many types. The subtrochanteric types are the ones that really give us trouble, particularly with reference to postangulation.

DR. R. C. WEBB, Minneapolis: It has been suggested that weight bearing might be started in some cases of intertrochanteric fractures of the femur after eight weeks. In this connection I should like to mention an experience with a 45 year old man who had an average type of intertrochanteric fracture of the left femur in good position except for marked coxa vara. The fracture was seven weeks old when I first saw him, and I applied 50 pounds (22.7 Kg.) of skeletal traction through the lower end of the femur for forty-eight hours. Although I nearly dislocated the hip downward, I found that the callus was still soft enough to permit restoration of the normal angulation to overcome the coxa vara.

DR. JAMES JACKSON, Madison, Wis.: It gives me great pleasure to be here and to see that there are many orthopedic surgeons who have been converted to the method of open reduction and internal splinting of fractures.

Thirty-six years ago, in 1912, I did my first open reduction at a time when this type of procedure was openly criticized by most surgeons. In fact, I appeared before a meeting of the Railway Surgeons in Chicago a few years ago, where I showed slides from some 200 cases of open reduction of fractures of the long bones. In a discussion of my paper a prominent Chicago surgeon said he did not believe a single word the author said.

Today, when men are doing such brilliant work with open reduction and internal splinting of fractures, I feel justified in having once been a bone surgeon.

DR. HAROLD B. BOYD, Memphis, Tenn.: The discussion has been interesting and instructive. I wish to thank all the discussers. Some of the points discussed are included in the written paper which time did not permit reading.

Dr. Speed, whom I admire very much, has brought to our attention the treatment of these patients by traction. There is no question that good end results can be obtained in trochanteric fractures by conservative treatment. The principal reasons for operating on these patients are medical and not surgical. Every surgeon cannot treat trochanteric fractures the same, but we feel that in the majority of patients open reduction and internal fixation is a good method. The patients are more comfortable; they are in the hospital on an average of two to three weeks, which is an economic saving to the family and also makes more hospital beds available. In hospitals with adequate nursing care the mortality is about the same in the nonoperative group as in the operative group. In hospitals without adequate nursing care for patients in body casts or in traction, the mortality is much less in the patients treated with internal fixation.

Surgical thinking should not be kept in logic-tight compartments. Patients should be treated in the manner which is best suited to the individual patient, the surgeon and the equipment with which he must work. We do not think that all trochanteric fractures should be treated with internal fixation in all circumstances and by all surgeons. But for our patients we feel that internal fixation in the vast majority is the method of choice.

# HEMIPELVECTOMY FOR MALIGNANT TUMORS OF THE BONY PELVIS AND UPPER PART OF THE THIGH

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PORTLAND, ORE.

HEMIPELVECTOMY is the term most frequently applied to the operative procedure in which the entire lower extremity with the adjacent innominate bone is removed through the sacroiliac and pubic joints. Other descriptive, though more cumbersome, designations for this operation are interinnomino-abdominal amputation,[1] interpelvi-abdominal disarticulation,[2] sacroiliac disarticulation [3] and disarticulation of the innominate bone.[4]

Hemipelvectomy offers the best method for eradication of primary, radioresistant malignant tumors of the ilium, ischium and pubis. It is also indicated for malignant tumors of the upper part of the thigh which encroach on or involve the innominate bone or pelvic parietes. A compromise with good surgical treatment of tumors has been made frequently in dealing with malignant growths of the upper part of the thigh by performing a disarticulation of the hip joint, a procedure in which it is often impossible to remove the tumor widely.

While only on hundred and thirty-eight hemipelvectomies had been reported in the literature to 1946, with a high operative mortality,

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From the Surgical Service of the United States Veterans Hospital.

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 4, 1948.

1. (*a*) Ghormley, R. K.; Henderson, M. S., and Lipscomb, P. R.: Interinnomino-Abdominal Amputation for Chondrosarcoma and Extensive Chondroma: Report of Two Cases, Proc. Staff Meet., Mayo Clin. **19**:193-199, 1944. (*b*) Gordon-Taylor, G.: A Further Review of the Interinnomino-Abdominal Operations: Eleven Personal Cases, Brit. J. Surg. **27**:643-650, 1940. (*c*) Morton, J. J.: Interinnomino-Abdominal (Hindquarter) Amputation, Ann. Surg. **115**:628-646, 1942.

2. Pringle, J. H.: The Interpelvi-Abdominal Amputation: Notes on Two Cases, Brit. J. Surg. **4**:283-296, 1916.

3. Pack, G. T., and Ehrlich, H. E.: Exarticulation of the Lower Extremities for Malignant Tumors: Hip Joint Disarticulation (With and Without Deep Iliac Dissection) and Sarco-Iliac Disarticulation (Hemipelvectomy), Ann. Surg. **123**: 965, 1946; **124**:1, 1946.

4. Sugarbaker, E. D., and Ackerman, L. V.: Disarticulation of the Innominate Bone for Malignant Tumors of the Pelvic Parietes and Upper Thigh, Surg., Gynec. & Obst. **81**:36-52, 1945.

recently the procedure has been performed more frequently and more safely. Pack [3] reported six such operations without mortality, and my colleagues and I have had a similar experience with five.

## TECHNIC

The technic of the operation originally described by Pringle[2] has been standarized by Pack.[3] A useful addition to this technic has been the temporary control of the common iliac artery.[3] The incision is made from the symphysis pubis, following the inguinal ligament to the anterior-superior spine of the ilium. It continues along the crest of the ilium and then directly downward just posterior to the greater trochanter, across the gluteal fold and upward to the point of origin. The attachments of the rectus abdominis muscle and the inguinal ligament to the pubis and iliac spine are divided. The inferior epigastric vessels are ligated and divided and the spermatic cord retracted. The peritoneum and the

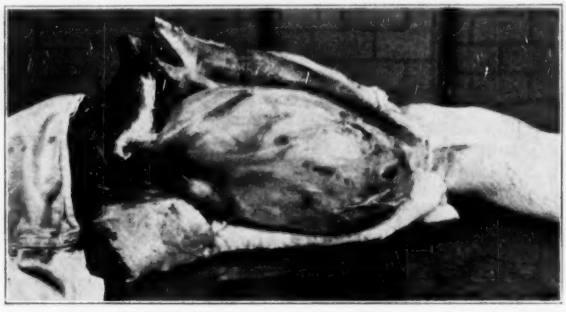

Fig. 1.—Gross specimen, showing rhabdomyosarcoma of upper part of the thigh in case 1.

bladder are retracted medially, exposing the iliac fossa. The common iliac, external iliac and hypogastric arteries are exposed, and a controlling tape is placed around the common iliac artery, the occlusion of this artery being maintained throughout the remainder of the operation. The external iliac artery and vein are transfixed, doubly ligated and divided. The muscles attached to the crest of the ilium are now divided. The symphysis pubis is then separated with an osteotome. The psoas muscle is divided as high as possible, the femoral nerve sectioned and the sacroiliac joint exposed. This joint is divided. It is almost always possible to divide the superior gluteal and obturator vessels and nerves during the anterior dissection.

The patient is now turned on the uninvolved side, and the posterior skin flap is developed back to the sacrum. The gluteus maximus muscle

attachment to the sacrum is divided and the muscle sectioned. The sciatic nerve is cut across, as are the piriformis and levator ani muscles. After division of the sacrotuberous, sacrospinous and sacroiliac ligaments, the extremity is removed. The controlling tape of the common iliac artery is removed and the skin flaps approximated with through and through interrupted sutures of silk.

## REPORTS OF CASES

CASE 1.—*Hemipelvectomy for rhabdomyosarcoma of the thigh, extending to the pubic ramus.*

H. R., a white man aged 31, was admitted to the Veterans Hospital, Portland, Ore., on July 9, 1948, complaining of a tumor of the left thigh of two and a half

Fig. 2.—Postoperative photograph of wound in case 1.

years' duration. The patient was injured in 1945 at Pearl Harbor by an explosion, which resulted in the development of a large hematoma on the posterior aspect of the left thigh. The hematoma gradually subsided, but six months later a hard, movable mass, 5 cm. in diameter, was noted on the medial aspect of the thigh. This mass gradually developed in size up to the time of his admission to the hospital. Examination revealed a huge, hard, tender mass covering the entire posterior and medial aspects of the left thigh, extending from the lower third of the thigh up to the pelvis. A roentgenogram of the chest was normal. A biopsy of the mass was performed on July 13, 1948. The diagnosis was fibrosarcoma.

*Operative Procedure (July 21, 1948).*—Hemipelvectomy was performed on the left side.

The convalescence was entirely uneventful. Constant gastric suction was maintained for four days, and a Foley catheter was left in the bladder for five days. There was no abdominal distention or urinary retention after removal of the tubes. There was primary healing of the wound.

Fig. 3.—Gross specimen, showing fibrosarcoma of the upper part of the thigh in case 2.

Fig. 4.—Photograph of wound twenty-one days after operation in case 2.

*Pathologic Changes.*—The specimen consisted of the left leg with the innominate bone (fig. 1). There was a hard, ovoid tumor mass, measuring 25 by 13 by 15 cm., occupying the posterior and medial aspects of the thigh, extending from the popliteal space to the inferior ramus of the left pubic bone. Microscopic sections revealed a varied picture. Those from the periphery of the mass showed the cells to be small and relatively uniform. The nuclei were rounded or oval, with fibrillary processes. There was evidence of invasion of the striate muscle. A

section from a deeper portion of the tumor revealed a markedly different picture. Here the tumor cells varied greatly in size and shape; some were tadpole shaped and others considerably elongated. Many of the cells had the appearance of striate muscle, and longitudinal and cross striations were clearly observed. The nuclei varied appreciably in size, shape and staining quality, and mitotic figures were occasionally observed. Various lymph nodes examined failed to reveal any evidence of tumor infiltration. The diagnosis was rhabdomyosarcoma of the left thigh.

Follow-up examination in November 1948 revealed a well healed, painless stump (fig. 2). Roentgenograms of the chest revealed no evidence of metastasis. Urinary and bowel control were normal.

CASE 2.—*Hemipelvectomy for fibrosarcoma of the thigh.*

J. W., a white man aged 60, was admitted to the Veterans Hospital, Portland, Ore., on Oct. 28, 1948, because of a painful mass in the upper aspect of the left thigh of two months' duration. Examination on admission revealed a firm, fixed mass in the anterior aspect of the upper third of the left thigh, 10 cm. in diameter. The mass extended to the inguinal ligament. Biopsy of the tumor revealed a fibrosarcoma.

*Results of Hemipelvectomy in 5 cases*

| Patient | Age | Diagnosis | Operation | Result |
|---|---|---|---|---|
| J. W..... | 20 | Osteochondrosarcoma, ilium | March 1947 | Died 13 mo. postoperatively from pulmonary metastasis |
| R. T..... | 38 | Osteochondrosarcoma, ilium | July 1947 | Well 18 mo. postoperatively; no metastasis |
| L. G..... | 32 | Osteogenic sarcoma, femur | November 1947 | Well 13 mo. postoperatively; no metastasis |
| H. R..... | 31 | Rhabdomyosarcoma thigh | July 1948 | Well 6 mo. postoperatively; no metastasis |
| J. W..... | 60 | Fibrosarcoma, thigh | November 1948 | Well 1 mo. postoperatively; no metastasis |

*Operative Procedure (Nov. 3, 1948).*—Hemipelvectomy was performed on the left side.

The convalescence was complicated by considerable serosanguineous discharge from the wound, which, however, healed firmly without infection (fig. 3). The patient is now ambulatory on crutches.

*Pathologic Changes.*—The specimen consisted of the left leg with the innominate bone (fig. 4). There was a hard, tumor mass, measuring 10.5 by 9.5 by 7 cm. occupying the anterior surface of the upper third of the thigh. The tumor had grown into the lumen of the common femoral vein, completely occluding it. Microscopic sections revealed variations in the appearance of the cells from different areas of the growth. In one part the cells tended to grow in whirls and bands and had the appearance of smooth muscle; in another section they were more widely separated. The nuclei were generally small, but frequently they were large and irregular. Atypical mitotic figures were observed occasionally. There was no evidence of cross striations, and spider cells were not observed. The lymph nodes failed to reveal tumor. The diagnosis was fibrosarcoma of the left thigh, with extension into the femoral vein.

Hemipelvectomy has been performed in 5 cases, including the 2 cases described, at the Veterans Hospital, Portland, Ore., since 1947 for primary malignant tumors of the innominate bone or upper part of the thigh. I have previously reported the first 3 cases.[2]

PROSTHESIS

A helpful prosthetic device has been constructed at the Portland Veterans Hospital for patients who have undergone hemipelvectomy. Ghormley [1a] reported the use of a belt for support of the pelvic contents.

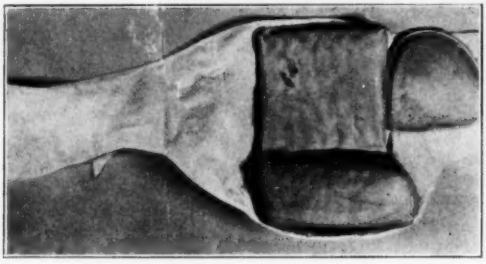

Fig. 5.—Photograph of prosthesis.

Fig. 6.—Photograph of patient wearing prosthesis (case 1).

The prosthesis referred to consists of a canvas belt in which three leather-covered pads are incorporated, these pads serving as a support to the abdominal wall and taking the place of the removed buttock

(figs. 5 and 6). This prosthesis makes it possible for the patient to sit upright with comfort, with weight equally divided on the remaining buttock and the prosthetic pad.

SUMMARY

1. Experience with hemipelvectomy in 5 patients with primary malignant tumors of the innominate bone or upper part of the thigh is outlined.

2. A useful prosthetic device to replace the removed buttock is reported.

## DISCUSSION

DR. KELLOGG SPEED, Chicago: This term "hemipelvectomy" I coined seventeen years ago, when I reported 2 cases before the Society. At that time there was no prosthetic support available for the care of such patients, but with the advance of the knowledge obtained in the war we are now able to help them, and, as Dr. Wise has shown you, we are now able to let them walk and thus overcome much of their disability.

This is a remarkable series of cases. Since I first made my report, I have had several chances to operate on patients, but I have never again been able to get the patient's permission. I daresay there are other men here who have done the operation.

The English surgeons laugh at the term "hemipelvectomy," and Pringle and others use the term "interileoabdominal amputation." That is a mouthful, but perhaps you prefer it.

DR. W. E. LEIGHTON, St. Louis: Of the first 10 cases reported in the United States, four members of the Western Surgical Association accounted for 7 of them. In 3 other cases operation was performed by Babcock, of Philadelphia, and Keene, of Philadelphia.

In regard to the reason why so few of these operations have been done, when a French surgeon was called on to perform one, he stated that he had never done the operation, he had never seen it performed and probably none of his confreres could give him very much information on the procedure.

That was my start in this amputation. I had never seen it done, and all I knew about it was what I had read of the few cases reported. I performed one and got a successful result; the man is still alive fourteen years later and walks around on crutches because we have never had anyone come to us who would fit a prosthesis that would be of use.

The term "hemipelvectomy" I have abbreviated and have called it the "hindquarter amputation," because it looks like removing the hindquarter of a beef. As in all operations for malignant growth, you cannot get much assurance of a cure by selecting a piece of bone to remove. The best cure for a malignant growth is a wide excision and amputation through the bone above. When you have a sarcoma of the pelvic bone, the only thing that promises any success is entire removal of the bone involved.

May I quote from a paper I wrote concerning the frequency of these tumors? "In Geschickter and Copeland's book on tumors, published in 1931, they collected 155 cases of sarcoma. In 86 of these cases the tumor was primary in the innominate bone; seven patients died following palliative treatment, such as excision or radiation. Only one was living at the end of twenty months, but the tumor was

still active. Among 88 cases of osteosarcoma collected by Geschickter, he found only one case in which the growth arose in the pelvis, and this patient did not survive palliative treatment. Upon analyzing the 108 cases that I collected in 1940, the operation was performed for sarcoma 73 times, and in 27 cases the disease was primary in the os pelvis; 13 patients recovered and lived from two months to five years or more; 14 patients died, most of them within a few hours, so the mortality rate of all the collected cases at that time was 51 per cent."

However, as Dr. Wise has shown, with careful technic the operation is easily done, and a good exposure is made by the procedure described. It is possible to take out the entire affected bone. A Spanish surgeon has given it the name, "interabdomino sacro-pubic disarticulation."

An opportunity should be given to the patient to recover, and he may recover, as shown by the number of cases reported and by my own personal experience with the first operation of this type I ever performed.

DR. MARTIN NORDLAND, Minneapolis: I had a case within the last year with a questionable diagnosis of a malignant tumor of the bony pelvis. I am not an orthopedist and have never been confronted with this problem before. I should like to have Dr. Wise tell me how to determine in an early case, or in one with a questionable diagnosis, what evidence is needed to make the decision to operate.

A healthy-appearing 31 year old man came to me with a severe pain in his left hip. The pain was of recent origin and could be relieved only with morphine. There was no history of trauma. There was nothing of significance revealed by the general physical examination save that a mass could be palpated in the left groin. The routine tests of the urine and blood, including a Wassermann test, gave a negative reaction. The roentgenographic studies of the pelvis, lumbar and sacral regions of the spine, left hip and upper portion of the left femur showed a lesion of the left ilium. The roentgenologist could not exclude a malignant growth. We felt that we were dealing with an osteomyelitic process. We hesitated to do a biopsy. We treated the patient with penicillin, and he made a slow but complete recovery.

DR. ROBERT A. WISE, Portland, Ore.: I wish to thank Dr. Speed, Dr. Leighton and Dr. Nordland for their discussion. In answer to Dr. Nordland, there is one fixed rule which I think we should always follow before contemplating a procedure as dismantling as this one, and that is that we should never, in any circumstances, perform this operation unless the diagnosis is proved by biopsy. In the case you mentioned, if there were any question of the lesion being a primary tumor in the region of the pelvis or the greater trochanter, I believe that an exploration, a biopsy and a paraffin section would be indicated. The pathologist's report should then be awaited.

I believe that the time has come when we should no longer consider this operation as a tremendous one or one to be looked on as a rarity or an oddity. The procedure should be a part of every surgeon's armamentarium. It is a mistake, I am sure, to condemn some of these patients to palliative radiation therapy when it is known that little can be achieved with that method of treatment or to subject the patient to disarticulation of the hip joint because that procedure is better known and either not remove the tumor widely or actually leave some of it.

Earlier we did three disarticulations of the hip joint for tumors of the upper part of the thigh and actually found that the postoperative course was longer, in 2 cases more severe, and the healing of the wound delayed for many months for the reason that with these tumors it is necessary to sacrifice the rectus femoris and the sartorius muscles, structures which are usually used to fill the acetabulum. When that cannot be achieved delayed healing is almost inevitable.

# CARCINOMA OF THE THYROID GLAND

ARNOLD S. JACKSON, M.D.
MADISON, WIS.

FOR years it was traditional never to give iodine to a patient having exophthalmic goiter and always to drain in a case of ruptured appendicitis with peritonitis. Universally, patients were confined to their beds for one or more weeks after operation. Spinal anesthesia was considered a dangerous anesthetic, to be used only in rare instances. Thousands of yards of gauze and adhesive tape were piled on the patients' abdominal incisions in the hope of protecting the incision from contamination and of strengthening the wound. My entire thirteen minutes could be devoted to a discussion of traditional ideas in surgery whose abandonment years ago might have saved thousands of lives which were unnecessarily sacrificed to the god of tradition. Tradition is the enemy of progress. So I believe that we have come to a new era in medical writing. In this busy world we have little time to read long medical articles written in traditional style. Instead we read the summary, and if it interests us, we may turn back and review a few paragraphs and occasionally the entire article. I have been asked to present the subject of carcinoma of the thyroid in thirteen minutes. By streamlining this article, by first presenting my conclusions after the manner of the press and by amplifying the most important of these facts in the remaining minutes I hope to set a style in medical writing that will encourage others to abandon the traditional form of the past.

A study of 40 cases of carcinoma of the thyroid gland revealed these facts:

1. In 90 per cent the carcinoma arose in a preexisting adenoma.
2. In 18 the condition was undiagnosed prior to operation.
3. Forty per cent of the tumors occurred in males.
4. The relationship of hyperthyroidism was inconsequential.
5. Eleven of the 40 patients were inoperable when examined.
6. Six patients remain well five years after operation.
7. In 1 patient a recurrence developed twenty-four years after thyroidectomy.
8. The incidence of carcinoma in this series was 5 per cent.

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 4, 1948.

Fig. 1.—Photomicrograph of a well differentiated papillary adenocarcinoma. There is slight cellular and nuclear pleomorphism and slight loss of cellular polarity. There is also invasion of the stroma by epithelial elements. Hematoxylin and eosin stain; × 180.

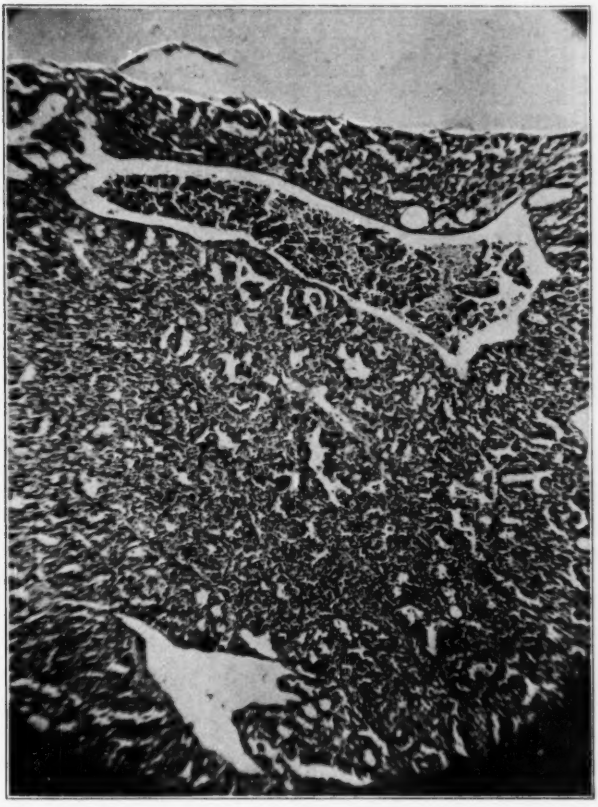

Fig. 2.—Photomicrograph of a well differentiated papillary adenocarcinoma of the left lobe of the thyroid. This is one of the less well differentiated areas. Note the large vascular space in the upper portion of the field which contains an embolus composed of tumor cells. Hematoxylin and Eosin stain; × 80.

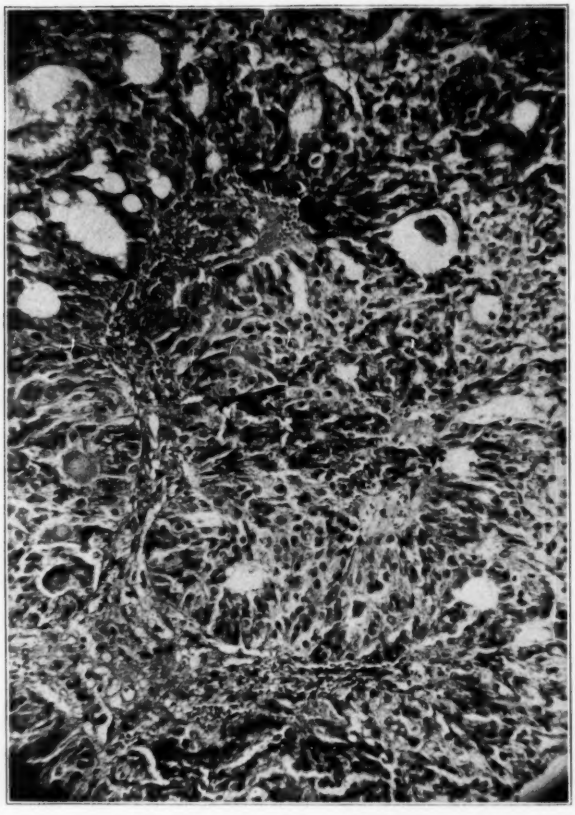

Fig. 3.—Photomicrograph of tumor of the midportion of the right tibia. It is composed of epithelial type cells having a glandular and papillary arrangement. Some of the acini contained homogenous deeply staining eosinophilic material resembling colloid. This suggested that the metastatic lesion was from a thyroid carcinoma. Hematoxylin and eosin stain; × 175.

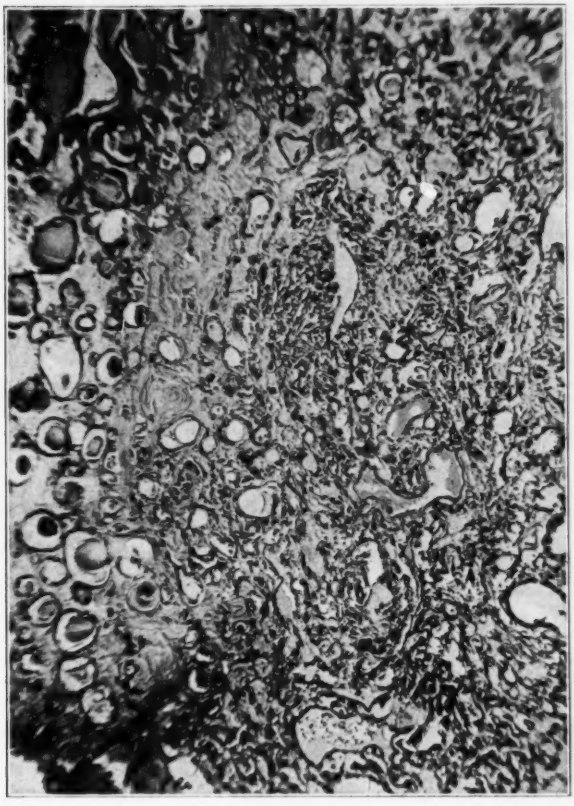

Fig. 4.—Photomicrograph of an adenomatous focus in the thyroid from the patient in the previous figure, showing considerable distortion of glands and isolated epithelial cells in the stroma. Other criteria of neoplasia are absent. Hematoxylin and eosin stain; × 190.

These conclusions are essentially in accord with the findings of other authors. Over one hundred articles dealing with this subject appear in the literature. Considerable difference of opinion has occurred concerning the pathologic classification and only serves to confuse the reader. The following classification is offered.

1. Papillary adenocarcinoma. This comprises about 33 per cent of the tumors, occurs at all ages but more frequently in youth and has the most favorable prognosis. The so-called aberrant thyroids, once thought to be congenital rests giving rise to malignant processes, are metastatic lesions of this type involving the adjacent cervical glands. Their complete removal, followed by a total excision of the thyroid lobe on the same side and a subtotal excision of the remaining lobes, offers a favorable prognosis.

Fig. 5.—Patient with malignant degeneration of adenomatous goiter, the source of a metastatic bone tumor in the tibia seen in figures 3 and 4.

2. Carcinoma arising in a preexisting adenomatous goiter. This comprises about one third of the tumors. If it is removed early, before the lesion has invaded the blood stream, the outlook is favorable. This type is frequently not recognized prior to pathologic examination.

3. Diffuse adenocarcinoma. This comprises most of the remaining growths. It is highly malignant and rapidly fatal.

4. The sarcomas and epithelial types. These are rarely seen, although the former occurred in 3 cases in this series.

The symptoms of a malignant growth of the thyroid unfortunately usually indicate that surgical treatment has been too long delayed and that only palliative roentgen therapy remains. A history of recent rapid growth of a goiter, dyspnea, aphonia and a fixed hard mass prognosticate death in most instances.

One other controversial subject appears in the literature. Pemberton and others have reported an incidence of cancer of 4 per cent in

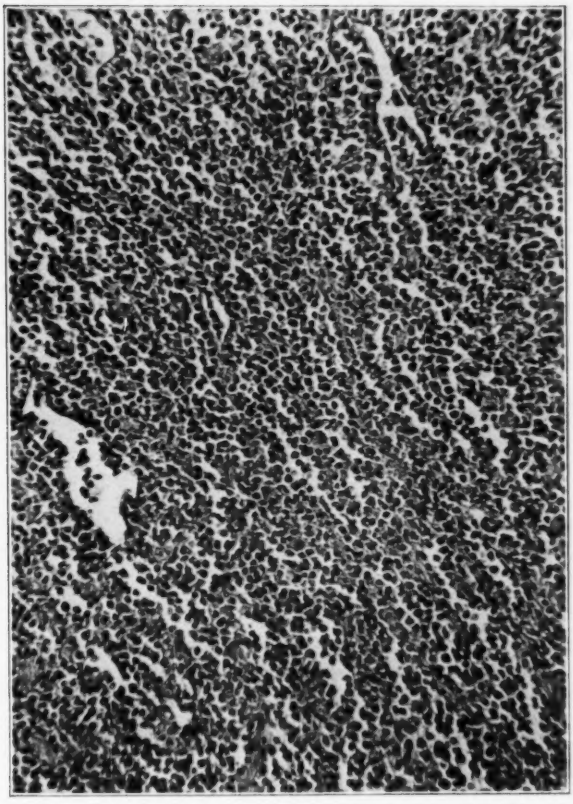

Fig. 6.—Photomicrograph of a reticulum cell sarcoma, clinically primary in the thyroid. Note the uniform small cells which comprise the tumor. Special stains show considerable reticulum intimately associated with the tumor cells. Hematoxylin and eosin stain; × 200.

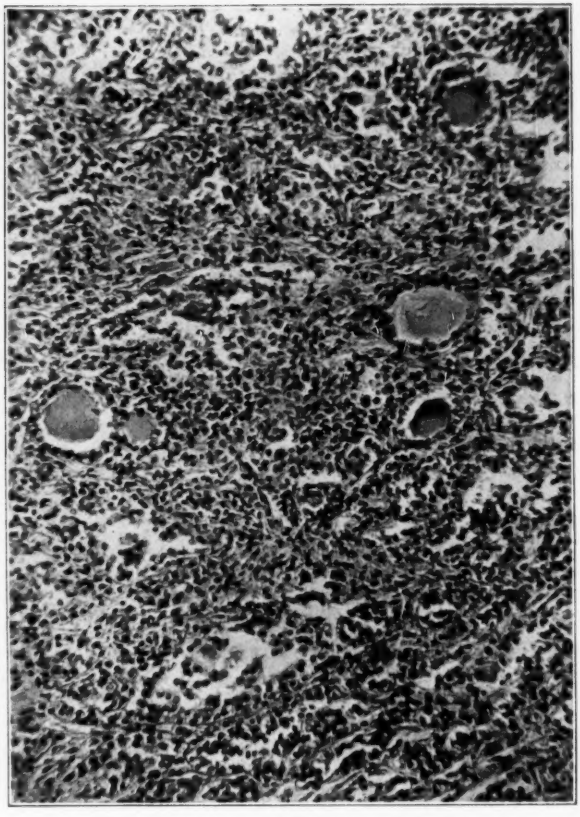

Fig. 7.—Photomicrograph of a representative portion of a section from a case of chronic thyroiditis which was misdiagnosed as a thyroid carcinoma in 1943. Note the acinous disarray. Many of the acini do not contain colloid and are lined by hyperplastic epithelium. Many of the small cells in the interglandular stroma are plasma cells and small lymphocytes. Hematoxylin and eosin stain; × 200.

cases of adenomatous goiter, whereas in 1945 Warren Cole started much discussion by reporting an incidence of 17.1 per cent in a series of 193 cases of nodular goiter, 11 per cent in 100 cases of the multinodular type and 24 per cent in cases of the solitary form. My own experience has recently shown an increase from 4 to 5 per cent, and I believe that if all adenomas that were seen were operated on this figure would possibly rise to 7 per cent.

Fig. 8.—This patient's condition was incorrectly diagnosed as a malignant disease of the thyroid by the pathologist in 1943. Subsequent study by other pathologists revealed chronic thyroiditis (see fig. 7).

Radioactive iodine has aided in the detection of carcinoma of the thyroid but has so far failed to effect a cure since it attacks some but not all of the malignant cells. Prevention, early operation, roentgen rays and radium are still the most effective means of treatment.

Carcinoma of the thyroid is the most easily preventable type of malignant growth. Since it arises in a preexisting adenoma in 9 of

every 10 cases, it could be eliminated in 90 per cent if all adenomas were removed when found. Most adenomatous goiters could be prevented by the use of iodine in the prevention of colloid goiter.

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## DISCUSSION

DR. MARTIN NORDLAND, Minneapolis: I believe that we have no trouble in convincing surgeons that adenomas should be removed for many reasons, including prophylaxis against a malignant process. I have noticed, as have you, that many of the medical profession, including good internists, are not so easily convinced. To some patients it is always a "lump in the neck." It is strange that so many internists and others use the basal metabolism rate as the criterion for surgical treatment. Dr. Jackson pointed out that they forget that hyperthyroidism itself is not necessarily the thing we have to worry about.

A simple definition of the word "goiter" years ago was "a change in the size or function of the thyroid gland." Hyperthyroidism so often is the main thought in the clinician's mind. In the absence of hyperthyroidism, he feels that surgical intervention is not warranted, and so the adenomas are forgotten. He apparently is guided by the old jingle, "Why bother the goiter until the goiter bothers you?" Since all malignant growths of the thyroid have their origin in a preexisting adenoma, any patient coming in with a "lump" in the thyroid gland should have the mass removed for this reason alone.

Unfortunately, the textbook description of malignant growths of the thyroid is the description of the far advanced malignant process. When the patient has pain and huskiness of voice, it is already far advanced and too late for successful surgical treatment. The time to attack it is when the patient has none of these symptoms. We remove goiters for cosmetic reasons, adenomas causing pressure symptoms and hyperthyroidism. Because it is a simple procedure now, with a mortality of less than 0.5 per cent, it should be recommended. As Dr. Jackson has pointed out, I believe that we should be more eager to remove these conspicuous and obvious tumors that seem not to trouble the patient.

DR. WARREN H. COLE, Chicago: Dr. Jackson has made many fine points about carcinoma of the thyroid and so concisely that I wish to reiterate a few of them: 1. Hyperthyroidism is inconsequential in carcinoma; 2. Too many patients with carcinoma of the thyroid arrive for surgical treatment in the inoperable state; in his series there were 27 per cent. 3. At least 95 per cent of aberrant thyroids are metastatic carcinoma of the thyroid. 4. If you wait until the symptoms of carcinoma are positive or diagnostic, you will be too late to attain a cure. 5. Radioactive iodine will not cure carcinoma of the thyroid.

I should like to add that carcinoma of the thyroid may be a geographic disease. For example, Dr. Slaughter, Dr. Rossiter and I have reported perhaps the highest incidence of carcinoma in all reports coming to my attention. I was talking to Martin Linden, and I apologize if he wanted to make the following comment himself. As you know, he is located in Salt Lake City, and in many years of surgical practice he has seen only 3 cases of carcinoma in hundreds and even thousands of cases of nodular goiter; furthermore, he told me that the 3 patients came from the Great Lakes area.

As Dr. Jackson said, we did report an incidence of carcinoma of 17 per cent in our cases of nodular nontoxic goiters, and I want to emphasize again that when talking about the incidence of carcinoma in all types of goiter if you add your cases of toxic diffuse goiter, it is like diluting your cases also with those of gallbladder disease and appendicitis, because carcinoma is rarely encountered in toxic diffuse goiter.

In our first series, reported in 1944, we had 36 cases of carcinoma. The incidence was much higher in the solitary type than in the multinodular type. Thinking that such a high incidence may have been a coincidence, we summarized the figures again in the 1944 to 1948 period. Strange to say, the figure for carcinoma in nontoxic nodular goiter again was 17 per cent, with a total of 16 cases.

If any of you think we are being too liberal with a diagnosis of carcinoma of the thyroid, I have an answer for you. It is a sad one, I must say. In this last series we have followed all our patients closely. Sixteen patients in this series were followed. Eleven are dead already of metastasis; an additional one has metastasis and will not survive much longer. Surely that is not being too liberal in the diagnosis.

I wish to make another point on incidence. A pathologist in the east has suggested that we use autopsy figures as an index of the incidence of carcinoma of the thyroid. I have a good answer for that, too. In the series from 1944 to 1948 we had 16 patients with carcinoma of the thyroid, and our department of pathology encountered only 2 patients with carcinoma of the thyroid in that period—yet 11 of ours had already died. The 2 patients encountered by the department of pathology actually came from the previous series. Finally, I wish to emphasize that prophylaxis is an important feature, i. e., prophylactic removal of the nodules while they are still benign.

Dr. Arnold S. Jackson, Madison, Wis.: I thought that in the last twenty-five years I had studied nearly all phases of the thyroid, but I had not studied malignant growths, and what knowledge I have derived from it I credit largely to the inspiration of Warren Cole, who stirred me up on the subject.

I know that in my own work my incidence of malignant growths has increased since I have acquired an excellent pathologist at my right hand and since all specimens are most carefully studied. Often the pathologist now reports a small area of malignant change within a large adenoma.

I think that as we look more and more carefully for malignant growths we are going to find a higher percentage of them. I have not been able to get up to Warren's figures, but mine are increasing, and I believe that he deserves a great deal of the credit for arousing those of us who are interested in this matter.

# THE ELDERLY PATIENT AS A SURGICAL RISK

## An Analysis of Three Hundred and Twenty-Two Operations Performed on Two Hundred and Forty-Four Patients Sixty Years of Age and Over

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AND
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WITHIN the last two years any surgeon, merely by casual reading of the group of medical journals which a surgeon ordinarily reads, could have encountered six separate articles on peptic ulcer in the aged.[1] That chance occurrence would probably not have been duplicated ten years ago or even five years ago. It is related to such a statement as that made by Zeman and Davids,[2] who, writing in 1948, mentioned a woman who had been denied surgical relief for a cystocele in 1938, when she was 68, but was safely operated on for it in 1945, when she was 75. Medical literature of this sort seems to carry two implications. The first is the increase in the population of this country in persons in the upper age brackets. The second is the increasing importance of these persons to physicians in general and to surgeons in particular.

Since the turn of the century there has been a remarkable increase in life expectancy, which in the United States is now well over 60 years of age. The increases, however, as Groom [3] pointed out, have not been uniformly distributed in all age groups. Between 1930 and 1940, for instance, while the whole population increased by only 7 per cent, there was an increase of 35 per cent in persons 65 to 74 years of age and an

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From the departments of Surgery and Internal Medicine, Vicksburg Hospital.

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 4, 1948.

1. Boles, R. S., and Dunbar, W.: Peptic Ulcer in Old Age, Geriatrics **1**:217, 1946. Carnozzo, S. J.: Pyloric Obstruction Due to Stenosing Ulcer in the Aged, J. Internat. Coll. Surgeons **10**:304, 1947. Spang, K.: Gastroduodenal Ulcer in the Elderly, Deutsche med. Wchnschr. **72**:605, 1947; abstracted, J. A. M. A. **136**:903 (March 27) 1948. Kiefer, E. D., and McKell, D. M.: Peptic Ulcer in the Aged, J. A. M. A. **133**:1055 (April 12) 1947. Lasher, E. P.: The Course of Peptic Ulceration in Elderly Persons: A Clinical and Anatomic Study of One Hundred and Twenty-Two Cases, Surgery **23**:501, 1948. Rafsky, H. A.; Weingarten, M., and Krieger, C. I.: Onset of Peptic Ulcer in the Aged, J. A. M. A. **136**:739 (March 13) 1948.

2. Zeman, F. D., and Davids, A. M.: Gynecologic Surgery in the Elderly with Special Reference to Risks and Results, Am. J. Obst. & Gynec. **56**:440, 1948.

3. Groom, W. S.: Mortality and Life Expectancy in the United States Since 1900, Geriatrics **1**:384, 1946.

increase of 38 per cent in those over 75 years of age. On the basis of these gains, it has been estimated that by 1980, 40 per cent of the population will be above 45 years of age, while the group above 65 years of age will number 22,000,000 and will constitute 14 per cent of the total population.

Whether or not one accepts these figures absolutely, it is impossible not to admit the trend they represent. It is also not possible to ignore their surgical significance. At the present time, surgical treatment of persons over 60 years of age constitutes a relatively small proportion of surgical practice. In the not distant future it will constitute a much larger proportion, both because of the increase in the population and because older persons, generally speaking, require more surgical treatment—and often procedures of far greater magnitude—than do younger persons.

The general belief that elderly persons do not tolerate surgical intervention as well as younger persons is borne out statistically and is sound physiologically. The poorer results can be chiefly attributed to the fact that the older person does not possess the organic reserve which the younger patient possesses, nor does he possess what might best be described as the elasticity of youth. He lacks the ability to snap back. On the other hand, an unfortunately large proportion of the mortality of surgical procedures in elderly persons can be explained not by the fact that they are elderly but by the fact that their disease has been permitted to become irreversible. There were numerous instances of this sort in the series of surgical cases which we are reporting in this communication, and some of these, we regret to say, could be attributed to the bad advice which the patients had received earlier. They had been told that they were too old for surgical treatment. Another explanation of the advanced state of disease often observed in elderly persons is that disease processes, particularly when they are inflammatory, are likely to progress rapidly in elderly persons. Acute appendicitis is an outstanding example; the pathologic process in this disease is often more advanced at the end of twelve or twenty-four hours in the elderly persons than it is at the end of forty-eight to seventy-two hours in the younger person. Finally, disease processes are often advanced in elderly persons because the diagnosis has been missed. The explanation in some cases is the atypical character of surgical diseases in older persons—appendicitis is again a case in point—while other cases can be explained by the fact that the surgical disease has been masked by the clinical manifestations of a preexisting organic disease.

Age in combination with a surgical disease no longer warrants an attitude of fatalistic resignation. On the contrary, such a situation is a mandate to evaluate the status of the patient, to estimate the magnitude of his risk, and to put into play every possible technical advance and adjuvant measure to carry him safely through his ordeal.

There is also a philosophic aspect to surgical intervention in the aged. The senile person is frequently 70 or 80 years of age, it is true, but persons advanced in years are not necessarily senile. Sometimes they are far younger mentally, biologically and even physically than persons chronologically their juniors by many years. Many a man past 60 has ahead of him the most productive years of his life: Winston Churchill, to use but a single illustration, was well over this age when he lifted the hearts of the world in the first dark days of World War II. The mature judgment and wide experience of older men and women constitute a much needed bulwark of strength in present day society. The United States lost many of her young men in World War I and World War II,

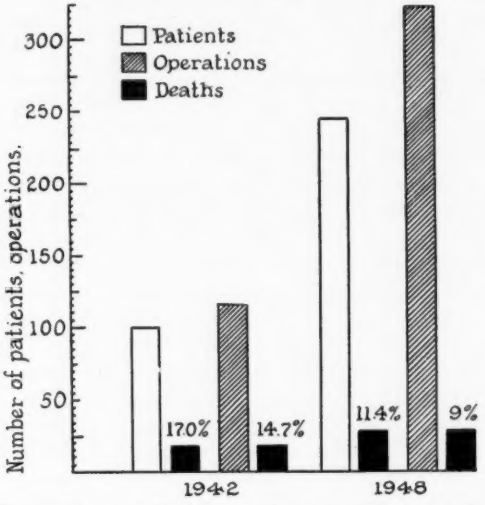


Fig. 1.—Comparative mortality in two series of operations on patients 60 years of age and over.

though we did not have, as did France and England, the experience of seeing the flower of our youth decimated twice in a generation. Now that we seem about ready to engage in another even more dreadful war, we cannot afford to overlook any means of conserving our population, regardless of its age.

## FACTORS OF MORTALITY IN THE AGED

In 1942 we presented (fig. 1) from the Vicksburg Clinic an analysis of 115 major surgical procedures performed on 100 consecutive patients 60 years of age and over, with 17 deaths.[4] This is a patient mortality of

4. Parsons, W. H., and Purks, W. K.: The Surgical Risk in Elderly Patients, South. Surgeon **11**:525, 1942.

17 per cent and an operative mortality of 14.7 per cent. The present communication consists of an analysis of three hundred and twenty-two operations performed by a single surgeon (W. H. P.) on 244 patients in the same age group between 1942 and October 1, 1948. There were 29 deaths in the second group, a patient mortality of 11.4 per cent and a surgical mortality of 9 per cent.

Before passing to a discussion of special factors of mortality, it might be said that the decrease in the mortality in the second series of operations in the aged can be explained by a number of general factors.

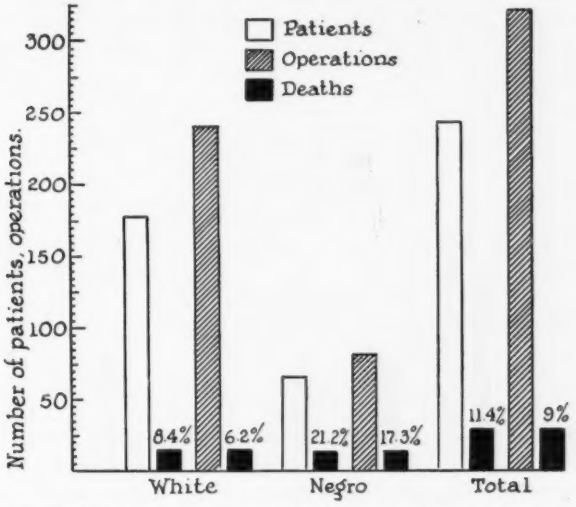


Fig. 2.—Racial mortality in 322 operations on 244 patients 60 years of age and over.

1. The increasing perfection of precision instruments and methods has made possible diagnoses which formerly could not have been established at all or could have been established only after a long delay. We trust, also, that our own diagnostic acumen has increased with the years. 2. Chemotherapy and antibiotic therapy have made enormous advances in the interim between these communications. Many patients in the earlier group were not treated with the sulfonamide drugs, the use of which was just becoming well stabilized at the time the study ended. In the second series, penicillin and streptomycin, which either did not exist or were not generally available for patients in the first series, unquestionably contributed to the lowering of the mortality. 3. The

chief reason for the decline in the mortality in the second series is our own increased awareness of the problems of surgical intervention in the aged, although, paradoxically, as time has passed we have found ourselves undertaking operations in this age group which a decade ago we would not even have considered.

At that, however, the mortality is higher for patients in the upper age brackets at the Vicksburg Hospital than is the over-all surgical mortality in this institution (1.08 per cent).

A mortality of 11.4 per cent per patient and 9 per cent per operation at first glance seems to warrant pessimism. When the figures are broken down, however, and are examined from various standpoints, certain apparently valid reasons for a more hopeful viewpoint emerge.

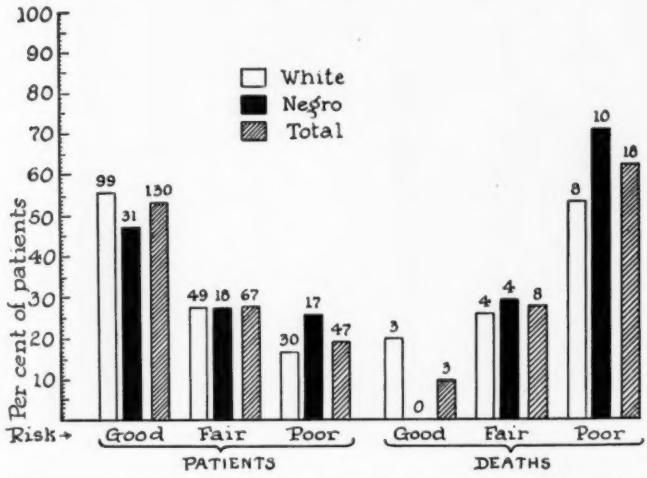


Fig. 3.—Proportionate distribution of mortality according to surgical risk.

RACE

First of all, like all surgeons in Southern hospitals, we must consider our mortality from the standpoint of race. There were 15 deaths in the 178 white patients in the series, 8.4 per cent, and 14 in the 66 Negro patients, 21.2 per cent (fig. 2). From the standpoint of separate procedures, there were 81 operations on the 66 Negro patients, the 14 deaths in this group giving a mortality of 17.3 per cent, and 241 operations on the 178 white patients, the 15 deaths in this group giving a mortality of 6.2 per cent.

When the cases are examined from the standpoint of the surgical risk they presented, the explanation of this wide discrepancy is immediately

apparent (fig. 3). The proportion of good risks in the Negro group was 47 per cent, as compared with the white proportion of 56 per cent. The proportion of fair risks in each group was approximately the same. The proportion of poor risks, however, was widely different, 16.8 per cent in the white group and 25.7 per cent in the Negro group. The distribution of deaths was, as might have been expected, in relation to the risks.

The differences in mortality between white and Negro patients unfortunately exist whenever comparative studies are made, as they should always be made in series consisting of patients of both races. In Boyce's material on acute appendicitis from Charity Hospital of Louisiana at New Orleans, for instance, which covers an almost sixteen year

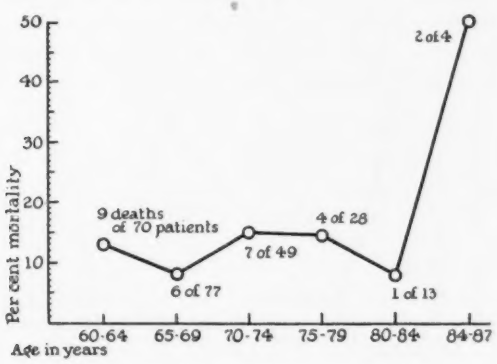


Fig. 4.—Surgical mortality according to age.

period, Negro paitents represented less than 30 per cent of the cases but more than 40 per cent of the deaths, the differences being even more pronounced in the upper age groups.

AGE

The 244 patients in this series were between 60 and 87 years of age. There was no sharp differentiation between the risk in the group of patients between 60 and 64 years and in the groups in the upper age brackets (fig. 4). When the statistics are broken down, some of the categories are not large and the fact that there were 2 deaths in the 4 cases in the age group 85 to 89 years is obviously of no significance. It is significant, however, that the variations in mortality in the various age groups seem to indicate that years in themselves do not turn the scale against the patient.

ANESTHESIA

Our opinion as to the role of anesthesia in the surgical mortality of aged persons has not changed from the time of our first report, when we considered it of small importance. There were in this second series no deaths which could be attributed solely to anesthesia, and we continue to believe that the skill and care with which the selected agent is administered make much more difference than the special agent selected. In other words, the anesthetist rather than the anesthetic matters.

A combination of agents was used in most of the 307 operations in this series in which the records contained data on anesthesia (fig. 5); the 15 cases in which the anesthetic agent was not recorded include 3 deaths. On the surface, the figures might suggest the superiority of one or two anesthetic agents over others and thus belie the statements

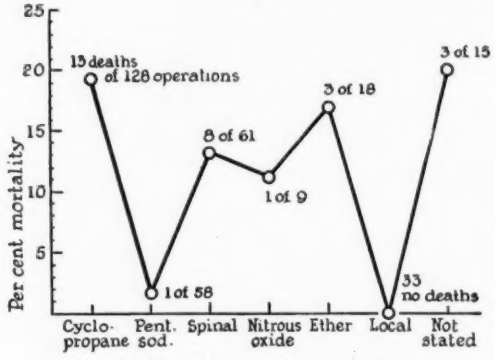


Fig. 5.—Mortality according to anesthesia.

we have just made. The interpretation, however, would be incorrect. Unless the cases were classified as to procedure and as to patient status, any conclusion would be misleading. Thus cyclopropane, for which the proportion of fatalities is highest, was used, on the whole, for the most serious operations, which frequently had to be performed on patients in only fair or in actually poor condition. Pentothal sodium, the use of which was also associated with a low mortality, was used chiefly as an adjuvant agent for gastrointestinal surgery; it was seldom used for prolonged operations. Local analgesia was always used for thyroidectomies but otherwise was not employed routinely.

The greatest care was taken in all details of the anesthetic routine. The preanesthetic medication was carefully selected for the individual patient. There was no set routine except that barbiturates were avoided as much as possible, while morphine, which was not always included in the preanesthetic regimen, was always used in small dosages. The

anesthetic plane was as light as was consistent with the necessities of the case. Oxygen was used freely, especially at the conclusion of the procedure. Particular care was taken to avoid variations in the blood pressure. Elderly patients do not tolerate abrupt changes, and a drop of any considerable degree, even in hypertensive patients, may, as Kountz and Jorstad pointed out,[5] cause disturbances of tissue function and thrombosis of small blood vessels.

### TECHNICAL ERRORS

Technical errors should play no greater part in the results of surgical intervention in elderly subjects than in those in young subjects, though the consequence of such errors is far more serious in patients in the upper age brackets because of their lack of physiologic reserve. Obviously, operation should be done by a competent surgeon; the elderly patient cannot withstand the attentions of a surgical novice. There can be no debate over the necessity for perfect asepsis, gentle handling of tissues and complete hemostasis. The loss of small amounts of blood is more serious in the elderly person than in the younger, as Kountz and Jorstad pointed out, because of the lessened ability of the vasomotor system at this age to contract as well as the lessened ability of the heart to increase its rate and output. The instantaneous changes in the vascular system which occur in young persons in response to changing conditions and changing blood volume are an enormous and often an unrealized protection. No such ability exists in the usual elderly patient, and small losses of blood may therefore introduce a major hazard.

So far as we can determine, technical error played a part in only 1 of the 29 fatal cases in this series. When the abdominal incision was being closed in a 71 year old Negro after subtotal gastrectomy for carcinoma of the stomach, the jejunum was inadverently caught in a suture. An intestinal fistula developed and leakage into the peritoneal cavity caused a subphrenic abscess. Death occurred on the eighteenth postoperative day from this combination of conditions.

Operation on the elderly person should naturally be performed in the shortest period that is consistent with good technic, but surgery, as Wangensteen has been foremost in pointing out, is not a marathon race, and in the properly prepared and properly anesthetized patient prolongation of an operation does not in itself introudce an additional risk. In this series the prolongation of the operation, in some instances to one hundred and eighty minutes, did not seem to be attended with harmful effects, and in no instance did the time spent on the operation seem to have any influence on the final outcome.

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5. Kountz, W. B., and Jorstad, L. H.: Special Problems of Poor Surgical Risks Among the Aged, Geriatrics **1**:341, 1946.

NATURE OF THE LESION AND OF THE CORRECTIVE PROCEDURE

The most important factor in the surgical mortality at any period of life is the nature of the disease process and the type of surgical procedure necessary to correct it. This was, of course, true in this series. These considerations can be conveniently analyzed by dividing the operations into elective and emergency ones and operations performed for malignant disease (fig. 6). The difference in the rate between white and Negro groups, already commented on, is evident in these categories too.

These terms, while they scarcely need definition, do need discussion. The emergency group of operations was associated with a relatively small mortality, but even if the deaths had been more numerous, the surgeon had no choice in the matter. In every instance the nature of the process was such that, had operation been withheld, the patient would

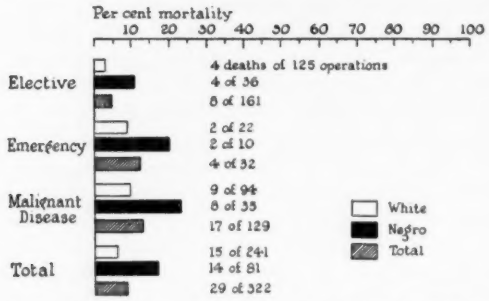


Fig. 6.—Mortality according to nature of lesion (procedure).

have lost his life or might have been left with a permanent disability. In 2 of the 4 fatal cases in this group, moreover, the patients were in such poor condition that the outcome was anticipated even before the operation was undertaken. The 2 other fatal cases in the emergency group represent the unhappy mischances that surgeons sometimes meet: A patient with acute appendicitis, in good condition, died of a pulmonary embolism on the fifteenth day, and a patient subjected to resection for an intestinal obstruction died of cardiorespiratory complications twenty days after closure of the colostomy.

The problem in emergency surgical intervention in the elderly, as at any age, is to prepare the patient as adequately as possible in the briefest possible time. The evaluation of the risk, as has already been intimated, is an academic matter in emergency surgery, though as a matter of fact the proportion of patients in poor condition was relatively small, many being seized with their illness or sustaining their accidents in the midst of good health.

The 89 patients subjected to 129 operations for malignant disease in a sense also represent an inevitable group: They all would have died, just as 17 of them did die after the operation, if treatment had not been instituted. In another sense, of course, they represent a selected group, in that they were subjected to surgical procedures rather than treated with irradiation or with such new agents as mustard gases and isotopes. At this time the latter are not generally available and have not yet been even partially evaluated. The basis of the selection of these patients for surgery was threefold. 1. The lesion was accessible. 2. The risk was not utterly prohibitive. (3). The malignant process was thought to be resectible or the patient's status was such that some sort of palliative procedure was necessary.

The 17 deaths in the malignant group can be viewed with a certain amount of equanimity because death would inevitably have occurred in the absence of treatment, though perhaps it might not have occurred so promptly. This group, however, introduces a delicate problem in surgical ethics. What should be the course of the surgeon in dealing with far advanced malignant disease? Will the patient's lot be happier if he stays his surgical hand? Or will it be improved if some palliative procedure is performed? This decision often cannot be made without exploration, and in no circumstances should this procedure, if it holds out a promise of cure or relief, be withheld merely because it may be followed by a fatal outcome. That is a justifiable, calculated risk. The patients' interests must be weighed in the balance and the decision made in the light of what is best for them.

The patients with malignant disease are not a group which permit any optimism. Seventeen of the 89 died in the hospital, but that is not surprising. Two of the white patients who died were in fair condition when operation was undertaken, and 6 were in poor condition; only 1 of the 9 was in good condition. Of the Negro patients who died, 1 was in fair condition and 7 were in poor condition; there were no good risk cases among the fatalities. Incidentally, 2 Negro patients with malignant disease, both of whom died, required emergency operation. One had a ruptured carcinoma of Meckel's diverticulum with advanced peritonitis, and the other had an incarcerated ventral hernia associated with an advanced ovarian malignant process.

From one point of view the cases in which elective operations were performed are the most important group in this series. In these cases surgical treatment might conceivably have been withheld. The patients might have lived for years, though all of them might have looked forward to discomfort and some of them to dangerous and potentially lethal complications in the future. They would not, however, have lost their lives at once, as 8 of the 126 did. These deaths represent the most

regrettable mortality in the series. Furthermore, it is, for the most part, an unexpected mortality. The patients in this group represented the best surgical risk, 90 being in good condition, 12 in fair condition and only 14 in poor condition. One death occurred in the good risk group, 5 in the fair risk group and 2 in the poor risk group. More attention will be devoted later to these considerations.

The 322 operations in this series represent a wide range of procedures (fig. 7) but need no special comment. Ninety-one, more than a quarter, were for genitourinary conditions in men, chiefly hypertrophy of the prostate. The majority of the gastrointestinal operations were for cancer, as were all but one of the operations on the breast; the single exception was for plasma cell mastitis. The fact that no deaths occurred in the seventeen operations on the thyroid on 11 patients deserves comment, as in several instances the degree of toxicity was extremely high. The 2

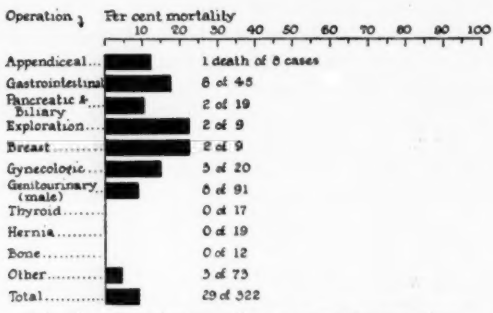


Fig. 7.—Mortality according to operative procedure.

deaths in nine exploratory procedures are a reflection of the poor status of the patients on whom the operations were carried out.

## PREOPERATIVE STATUS

Next in importance to the nature of the disease present and the procedure necessary to correct it are the associated complications which exist before operation. Their proper evaluation and management constitute a highly significant factor in the evaluation of the surgical risk, in the development of postoperative complications and in the ultimate mortality. In no other field of medicine is close cooperation between the internist and the surgeon more vital to the patient's welfare. A casual examination on the threshold of the operating room is not sufficient. Preoperative study implies, on the contrary, a careful study of the patient as a whole, with particular reference to his cardiovascular, renal and respiratory systems, his hepatic function and his nutritional status. It

also implies a study of his mental status and spiritual outlook, these intangible factors, as will be pointed out shortly, being extremely important in the elderly patient.

Detailed surveys of this kind naturally cannot be made on patients who must be subjected to emergency surgical treatment, even though in that category there is an irreducible minimum of studies which must be carried out before operation. There is seldom any excuse for an inadequate preoperative evaluation of patients with malignant disease and never an excuse for omitting such studies in patients in the elective group.

Twelve of the 66 Negro patients in this series, 18.2 per cent, and 51 of the 178 white patients, 28 per cent, presented no evidence of preoperative abnormalities. All the remaining patients presented one or more complicating conditions. Some of these conditions, such as orthopedic and minor genitourinary complications, did not influence the end results, but most of them, particularly cardiac and renal complications, were more serious; they accounted for some of the fatalities, and in the absence of proper evaluation and treatment they would undoubtedly have accounted for more.

These complications can be roughly divided into the following groups, in the first three of which there is considerable overlapping:

1. Cardiac, including hypertensive and valvular heart disease, auricular fibrillation, angina pectoris and congestive failure, as well as cardiac enlargement and electrocardiographic abnormalities.

2. Hypertensive, including simple hypertension and hypertension associated with cardiac and renal disease.

3. Renal, including impairment of renal function of various degrees and gross renal disease.

4. Nutritional, including severe anemia, cachexia, malnutrition, dehydration, hypoproteinemia and avitaminosis.

5. Metabolic, chiefly diabetes mellitus.

6. Respiratory, including bronchial asthma, pulmonary emphysema and chronic pulmonary suppuration.

7. Miscellaneous, including psychoses, paralysis agitans, dementia paralytica, hemiplegia and pathologic obesity.

The distribution of complications in general conformed with the distribution of good, fair and poor risks. The patients who underwent the emergency operations, as already mentioned, presented the fewest complications, and the large proportion, particularly of the nutritional variety, was in the group with malignant disease. Generally speaking, too, the severest complications occurred in this group, in which surgical treatment was absolutely essential.

POSTOPERATIVE COMPLICATIONS

The postoperative course of these patients was on the whole remarkably smooth. The twelve respiratory complications, six of which were atelectatic in character, represented the largest single group. There were five instances of wound disruption, almost evenly distributed between Negro and white patients and among the elective, emergency and malignant groups, and three instances of psychoses. The six instances of postoperative hemorrhage all followed operations on the prostate. Among the nonfatal cases there were two instances of phlebothrombosis, in one of which the condition went on to embolism, and one instance of embolism.

This low incidence of complications was accomplished by bringing into play in the postoperative management of the patients all the resources of the modern armamentarium, that is, intravenous therapy, including transfusion; chemotherapy and antibiotic therapy; constant intestinal decompression and early ambulation, or, when this was impossible, directed exercises in bed; oxygen therapy, and such other forms of therapy as seemed indicated in the special case.

It is extremely important that these measures be employed prophylactically in elderly patients subjected to surgical procedures. When complications have actually developed, they are often no longer effective. Elderly patients are particularly prone to respiratory and vascular complications, which they surmount with difficulty. Allen and his associates [6] are so fearful of vascular complications after operation that they practice venous ligation in patients over 50 years of age who are subjected to operation, and we ourselves are approaching the idea of using dicumarol therapy routinely in these circumstances.

A point of special importance in both preoperative and postoperative therapy is that, important as is the maintenance of a proper fluid balance, it is equally important not to overload the cardiovascular system of the elderly patient. In the upper age groups the introduction of even small amounts of fluid may produce cardiac failure because the cardiovascular system has lost the distensibility of youth. In this same connection Coller's [7] warning against the excessive use of salt should be remembered. Wangensteen [8] has suggested that the simplest means of avoiding over-

6. Allen, A. W.; Linton, R. R., and Donaldson, G. A.: Venous Thrombosis and Pulmonary Embolism, J. A. M. A. **128**:397 (June 3) 1945.

7. Coller, F. A.; Campbell, K. N.; Vaughan, H. F.; Iob, L. V., and Moyer, C. A.: Postoperative Salt Intolerance, Ann. Surg. **119**:533, 1944.

8. Wangensteen, O. H.: Abdominal Surgery in Old Age, Including Comment on (1) Use of Sipper; (2) Safety of Multiple Simultaneous Operations; (3) Mechanism of Development of "Bed Sores," Journal-Lancet **64**:178, 1944.

chlorination is to weigh the patient daily, especially the patient who is being treated by constant suction and who therefore cannot gage his own intake.

### MORALE

It is scarcely necessary to remind physicians or nurses who have cared for elderly patients that the greatest patience and tact are required for their management. In things that do not matter their established habits should be interfered with as little as is compatible with proper professional care. They do not tolerate restrictions, however reasonable, to which more youthful patients would submit willingly. For this reason they should be gotten out of the hospital and back into their own surroundings as promptly as possible. They require sympathy and tact, and they are particularly susceptible to personal attentions, which from the medical standpoint are not at all necessary but which actually contribute a great deal to their well-being and to their recovery. As Knight and Baird have pointed out, the attitude of resignation and apathy which many older patients display simplifies the task of the anesthetist, though the absence of a fighting spirit becomes a handicap after operation.

### ANALYSIS OF DEATHS

It would be of great advantage, though at present it does not seem possible, if one could determine which patients in the elderly group were likely to die, so that surgical treatment could be withheld from them. An analysis of the 8 deaths in this group is not a great help in this connection. It reveals the following facts:

The 4 deaths in the 28 Negro patients all occurred in hypertrophy of the prostate, 3 in patients in fair condition and 1 in a patient in poor condition. There was a renal or a uremic factor in all instances. One patient in the white group who underwent an elective operation also died, of pneumonia, after prostatectomy.

The other 3 deaths in the elective group all occurred in white patients. One, due to coronary thrombosis and sclerosis, followed cholecystectomy in a patient classified as a fair risk, though she presented sinus tachycardia before operation. The second death, which was due to uremia, anuria and acute glomerulonephritis, followed gastrectomy for an old perforated duodenal ulcer in a patient classified as a good risk. The third occurred in a woman subjected to resection of the sigmoid for fibrolipoma. She was in fair condition, in spite of a previous attack of coronary occlusion, and, so far as we could determine, she died merely because she had no special desire to live.

While all the 8 deaths just described occurred in the group of operations classified as elective, in the majority of cases the conditions for

which they were performed were urgent, and in no instance could the operation be considered as anything but necessary.

Only 1 of the 17 deaths following operation for malignant disease occurred in a patient in good condition. This man, who was subjected to one stage abdominoperineal resection for adenocarcinoma of the rectum, had moderate hypertension (158 systolic and 70 diastolic) and albumin (3 plus) in the urine. A severe reaction occurred after every attempt at intravenous therapy, and death followed on the fifth postoperative day from lobar pneumonia. Postmortem examination revealed cardiac hypertrophy and moderate coronary sclerosis, neither condition being sufficient in itself to explain the fatality. Postoperative care in this case was perhaps not as adequate as it might have been; possibly more earnest attempts should have been made to conquer the difficulties with which intravenous therapy was associated.

Most of the deaths from carcinoma could be attributed not so much to the operation performed as to the regettable state which the patient had reached before surgical intervention was undertaken. Sometimes the advanced disease was the fault of the patient himself, but sometimes it was the fault of the physician, who had failed to make the diagnosis or whose outlook on malignant disease in a patient in the upper age brackets was so somber that he failed to suggest the possibility of surgical treatment while cure was still possible.

Permission for postmortem examination was obtained in 2 of the 14 deaths in Negro patients and in 8 of the 15 deaths in white patients. Even when such studies were made, however, they were not always conclusive, and an attempt to correlate preoperative complications and the causes of death was not entirely satisfactory.

Renal failure was the most frequent cause of death (fig. 8), although only 16 instances of gross renal disease were recognized. It accounted for 9 of the fatalities, in contrast to only 5 fatalities from hypertensive and cardiac complications, which were recognized before operation in 152 patients. One of the cardiac deaths occurred in a patient subjected to an elective operation, who had no preoperative evidence of cardiac disease; it was attributed to advanced coronary sclerosis. There were 3 deaths from congestive failure, and the fourth in a patient with malignant disease was the result of coronary occlusion and cardiac infarction.

The relatively small proportion of deaths from cardiac failure is interesting in view of the belief, which still generally persists, that a patient with cardiac disease is a poor risk for surgical intervention. Actually, if his complicating medical state is properly managed, this is

not true. Studies by Butler, Feeney and Levine[9] and by Purks[10] some years ago, as well as a recent study by Morrison, make this point clear. Naturally the risk is greater in some varieties of heart disease than in others. According to Morrison,[11] whose conclusions are based on 701 operations in 478 patients, the greatest risk is in older subjects with rheumatic heart disease, of which there was no instance in this series.

The second most frequent cause of death in this series was pulmonary embolism, which was clearly responsible for 5 deaths and possibly played a part in a sixth. Exactly what part cardiac and other preoperative complications played in this type of death it is difficult to say, but, as 4

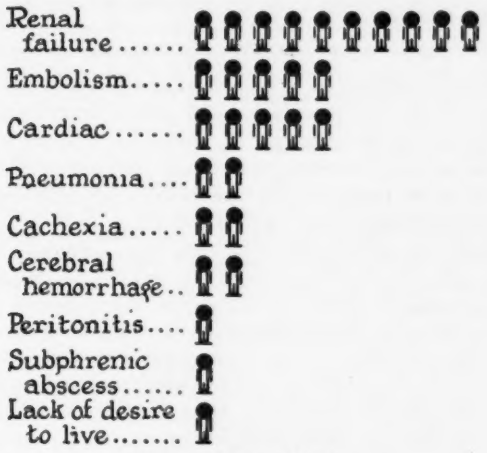


Fig. 8.—Causes of death.

of these 5 fatalities show, they are not the sole explanation of such catastrophes.

Two of the remaining deaths were attributed to pneumonia, 2 to cerebral hemorrhage, 2 to cachexia, and 1 each to peritonitis, subphrenic abscess, and, in the case already mentioned, an apparent lack of desire to live.

We have considered that a relationship exists between the preoperative status and the cause of death when a patient with recognized

9. Butler, S.; Feeney, N., and Levine, S. A.: The Patient with Heart Disease as a Surgical Risk: Review of Four Hundred and Fourteen Cases, J. A. M. A. **95**:85 (July 12) 1930.

10. Purks, W. K.: The Cause of Death of Patients with Organic Heart Disease Subjected to Surgical Operation, Ann. Int. Med. **7**:885, 1934.

11. Morrison, D. R.: The Risk of Surgery in Heart Disease, Surgery **23**:561, 1948.

hypertensive or renal disease dies of uremia, when a hypertensive subject dies of cerebral hemorrhage or when a recognized hypertensive or cardiac subject dies of a cardiac condition. We have also assumed that such factors as extreme obesity, congestive heart failure and severe anemia are predisposing causes of embolism, since the incidence of embolism is higher when they are present. On these grounds, a correlation was demonstrable between the preoperative status and the cause of death in 16 of the 29 fatal cases. Whether all these fatalities could have been averted is questionable, but it is at least fair to say that the possibility of the relationship introduces the need for surrounding the elderly patient all through his hospital course with precautions which may sometimes prove unnecessary but which at other times may avert a fatality.

## SUMMARY AND CONCLUSIONS

1. Surgical intervention in elderly persons (over 60 years of age) is becoming a matter of concern to surgeons as the population in this age bracket continues to increase.

2. The factors of mortality have been analyzed in 322 operations performed on 244 patients in this age group at the Vicksburg Hospital over a recent approximately six year period.

3. There is a sharp difference, in favor of the white race, between the mortality rates in white and Negro subjects, to be explained by the greater proportion of good risks among the white patients. Age itself, anesthesia, technical considerations and duration of operation are not important factors of mortality. The nature of the lesion and the procedure necessary to correct it, together with the preoperative complications present and the manner in which they are handled, ultimately determine whether the patient shall live or die.

4. An endeavor to correlate preoperative status with postoperative mortality, while not entirely successful, even in cases which came to autopsy, permitted the conclusion that in 16 of the 29 fatalities in this series such a correlation existed. Whether all these fatalities could have been prevented is highly doubtful, but there is no doubt of the necessity of surrounding the elderly surgical patient with every care and precaution. They frequently prove unnecessary, but they may be lifesaving.

## DISCUSSION

DR. WILLARD BARTLETT JR., St. Louis: I have had the pleasure of visiting Dr. Parsons and seeing him work. Those of you who have had a similar experience, and who know how his mind works, readily understand how thoughtfully he has evaluated his own experience.

My generation has seen the rise of the multiple stage operation on persons who present particular handicaps especially from the nutritional point of view. There is obviously a move away from stage operations today, as our ability to evaluate

operative risk, our understanding of biochemical and physiologic derangements and our methods of maintaining life in the seriously depleted persons improve. However, there are still a few procedures for the handicapped group of patients, particularly the aged, that are not regularly receiving as much attention as they deserve.

(Slide) This cholangiogram illustrates one such procedure, the two stage approach to the obstructed common bile duct. The patient shown here is typical of a few persons whom we have handled over the years by this method. I would not put this in print, but we have not had a death in such a patient during my twenty years in practice. This woman was 69 when she came to us in 1933, deeply jaundiced after five years of biliary colic and ten days of jaundice, chills and fever, with obvious cholangitis. Because of her fear of eating over a period of years, her weight had dropped by more than 33 per cent, from an average of 150 pounds (68 Kg.) down to something like 110 or 112 pounds (49.9 to 50.8 Kg.). We opened her gallbladder and cleared it of stones and assured ourselves that the cystic duct was open. After my father's practice, we put a mushroom catheter (which is the only kind you can keep in any hollow viscus, as you know) in her gallbladder. She made a smooth recovery and was discharged from the hospital wearing the catheter clamped.

During the succeeding six months she regained her weight and appetite; her hemoglobin and blood counts were restored to normal. This sidetrack of the biliary tract provides a safety valve, and one frees the patients of the complications of jaundice, including infection. In the cholangiogram you can see the stone at the lower end of the common duct, which in the interval between operations occasionally would impact. During her stages of impaction, in the presence of this self-retaining catheter in the gallbladder, bile would be diverted to the outside, and she would stay free of fever and of evidence of infection and free of jaundice. She would have only mild, transient colic for a day or two, not sufficient to require morphine, and she would not be really incapacitated by these episodes of impaction of the stone.

After six months, with her restoration to essentially normal health, exploration of the duct was done, the stone removed and the gallbladder removed. She was then 70 years old, and is well today at 84. I recommend the procedure for your consideration when dealing with such persons.

Dr. R. L. Sanders, Memphis, Tenn.: It was my privilege to sponsor Dr. Parsons as a member of this association. After hearing his paper today, I am sure you will agree with me that his presentation has been an excellent one.

Dr. Parsons is from the deep South, and his observations are especially noteworthy in that they include both the white and Negro races. In spite of the opinion of certain widows in New York state, we still have Negroes in the South who live more than sixty years. The paper by Drs. Parsons and Purks has clearly shown this fact. No doubt the lives of our Negroes will continue to increase in length; those of us who live in the South like them and appreciate them, and we therefore take good care of them.

It is my opinion that anyone who lives more than sixty years was made of good material in the first place. For this reason, I do not fear to take some risk in operating on elderly persons. They usually withstand major operations well.

Dr. W. H. Parsons, Vicksburg, Miss.: Of course I am in complete agreement with Dr. Bartlett that there is a definite place for stage operations and that in certain circumstances and conditions the surgical risk definitely is lessened by

so wise a choice. I had some difficulty, as most surgeons have, in educating my medical colleagues in the possibilities of operations on elderly patients. It is, however, only fair to state that the co-author of this paper has taught me that elective operations ought not to be done on persons known to be in poor condition. It is better perhaps to permit these patients to make their exitus unaided by the surgeon's hand.

We wish to thank those who have discussed this paper, and finally we wish again to repeat that, in our judgment, elderly patients present definitely a greater surgical risk than younger persons but that this risk, except in dealing with patients having conditions which require emergency operations, can be recognized preoperatively and many of these elderly patients can be made acceptable for surgical procedures, which in fact often will save their lives and even more often will add to their comfort.

# CONGENITAL ANORECTAL ATRESIA

## Report of a Case

ROBERT J. PATTON, M.D.
SPRINGFIELD, ILL.

THE CONGENITAL malformation wherein a normal anus is separated from a blind rectal pouch is classified by Ladd and Gross [1] as type 4 (fig. 1). It constitutes a small percentage of anorectal anomalies but is reported to bear a high mortality. The following discussion, which concerns only the type 4 anomaly without urogenital fistula, raises the question whether a discarded surgical procedure, transabdominal repair of the defect, may be performed without increased hazard and with satisfactory result.

With the risk of deemphasis of the fundamental problem of the structural fault in cases of this malformation, brief mention will be given of the embryologic developments involved (fig. 2). As the cloaca is divided into separate urogenital and intestinal systems at about the seventh week by the urorectal septum, the perineum is formed. The proctodeum develops from the ectoderm, and an external opening is formed by rupture of the anal membrane about the eighth week. The anal sphincter forms separately. The rectal tube is swollen in two areas, the bulbus analis superiorly and the bulbus terminalis, a transient swelling, inferiorly. An obliteration between these bulbs is probably the cause of the abnormality classified as type 4.

Associated congenital anomalies in other organs are commonly reported and constitute an important factor in the high mortality rate.[2] Extensive atresia of the rectal pouch or, indeed, of the entire colon may complicate the type 4 anomaly.[3]

In combining several authors' series in an attempt to establish the incidence and the usual surgical treatment of rectal atresia with normal

Read at the Fifty-Sixth Annual Meeting of the Western Surgical Association, St. Louis, Dec. 4, 1948.

1. Ladd, W. E., and Gross, R. E.: Abdominal Surgery of Infancy and Childhood, Philadelphia, W. B. Saunders Company, 1941.

2. (*a*) Bacon, H. E., and Hering, A. C.: The Surgical Management of Congenital Malformations of the Anus, Rectum and Colon, J. Arkansas M. Soc. **45**:41 (July) 1948. (*b*) Wangensteen, O. H.: Intestinal Obstructions, ed. 2, Springfield, Ill., Charles C Thomas, Publisher, 1942. (*c*) Ladd and Gross.[1]

3. Bowers, W. F., and Cook, M. M.: Congenital Atresia of the Pelvic Colon, Arch. Surg. **34**:868-873 (May) 1937. Rhoads, J. E.; Pipes, R. L., and Randall, J. P.: A Simultaneous Abdominal and Perineal Approach in Operations for Imperforate Anus with Atresia of the Rectum and Rectosigmoid, Ann. Surg. **127**:552-556, 1948.

anus, it becomes apparent that some cases classed as type 4 [4] present merely an anal dimple, and in another report [2a] cases are grouped together regardless of the presence or absence of a normal anus. However, among 311 cases [5] the type [4] of anomaly without fistula was encountered in 25 instances (8 per cent).

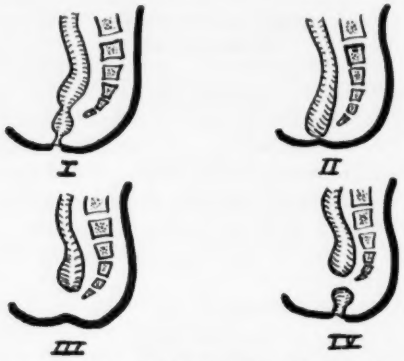


Fig. 1.—Types of anal and rectal abnormalities (after Ladd and Gross).

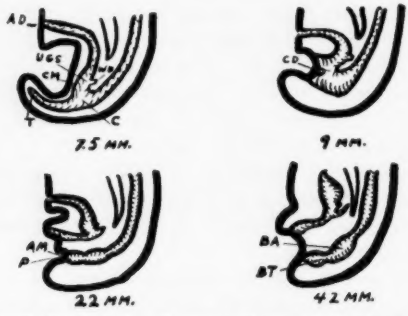


Fig. 2.—Normal development of anus and rectum at 7.5, 9, 22 and 42 mm. stages. *AD*, allantoic duct; *UGS*, urogenital septum; *CM*, cloacal membrane; *T*, tailgut; *WD*, wolffian duct; *C*, cloaca; *CD*, cloacal duct; *AM*, anal membrane; *P*, proctodeum; *BA*, bulbus analis; *BT*, bulbus terminalis (after Ladd and Gross).

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4. Berman, J. K.: Congenital Anomalies of the Rectum and Anus, Surg., Gynec. & Obst. **66**:11-22, 1938.

5. Brenner, E. C.: Congenital Defects of the Anus and Rectum, Surg., Gynec. & Obst. **20**:579-588, 1915. Crowell, E. A., and Dulin, J. W.: Congenital Anomalies of the Anus and Rectum, Surgery **7**:529-539, 1940. Dmytryk, E. T.: Congenital Malformations of the Anus and Rectum, Arch. Surg. **50**:253-257 (May) 1945. Harken, D. E.: Congenital Malformations of the Rectum and Anus, Surgery **11**:422-435, 1942. Ladd and Gross.[1]

The immediate problem in such cases is the relief of obstruction, whether it be by reestablishment of the continuity of the bowel or by colostomy. The methods and results of treatment are clearly outlined by Ladd and Gross, who cured 4 patients and lost none with primary perineal proctoplasty alone, but this operation was fatal in a like number in whom resort was finally made to colostomy after unsuccessful perineal operations. Colostomy alone resulted fatally in 6 of 7 cases, all poor risks. Two of 3 patients were cured by delayed perineal operation after primary colostomy. A single patient subjected to combined abdominoperineal operation died. Their total mortality rate in 9 cases was 57 per cent; 6 patients were living and normal, and 2 were living who had permanent colostomy openings.

## REPORT OF A CASE

A premature male infant 56 hours of age, weighing 3 pounds 14 ounces (1.7 Kg.), was first seen on May 6, 1946 because he had passed no meconium. He had a weak cry, appeared toxic and was mildly icteric; the abdomen was tensely distended. An enema was not retained and returned clear. A finger inserted into the normal-appearing anus met with a complete obstruction 1.5 to 2.0 cm. above the anal margin; the sphincter appeared normal.

Roentgenograms made with the infant inverted, after the manner suggested by Wangensteen,[6] and with a hemostat in the anus revealed the gas-filled rectal pouch to lie superior and anterior to the anal pouch and to be separated from the anus by a complete septum (fig. 3). The pouches were too widely separated to undertake incision of the septum with safety.

After preliminary gastric lavage and a transfusion of 45 cc. of blood, the infant was taken to the operating room at the age of 62 hours. The anus was inspected with a small endoscope, and an attempt to discover a lumen in the occluding septum was not successful. Accordingly, under local anesthesia, a sigmoid colostomy was performed, and a catheter was inserted into the proximal limb, which promptly drained meconium freely. Oral feedings were begun on the same day, penicillin was administered and the infant remained in an incubator with supplementary oxygen. Fluids and blood were administered parenterally. His weight dropped to a minimum of 3 pounds 5½ ounces (1.4 Kg.) on the seventh postoperative day. Because the catheter eroded through the bowel at the skin edge and caused some necrosis of the margin of the wound, succinylsulfathiazole was given during the second postoperative week. The colostomy opening was divided on the fifteenth day. He was discharged on the sixty-sixth postoperative day, weighing 5 pounds 14 ounces (1.7 Kg.).

He progressed satisfactorily during the ensuing year and was readmitted for the next stage of the operation at the age of 14½ months. A urethral catheter was placed into the bladder, and another was passed into the distal colostomy loop; a sound was placed into the anal pouch. Ether anesthesia was used, and the abdomen was opened through a lower right rectus incision. The blind rectal pouch was found to terminate beneath the pelvic peritoneum, being fixed to the region of

6. Wangensteen, O. H., and Rice, C. O.: Imperforate Anus, Ann. Surg. 92:77-81, 1930.

the base of the bladder, with no evidence of fistula. The anal pouch lay inferior and posterior to the rectal pouch, being separated from it by a distance of several millimeters. An anastomosis was performed between the end of the opened anal pouch and the side of the rectal pouch with a single layer of interrupted fine silk sutures, and the pelvic peritoneum was allowed to fall in place over and above the suture line. A catheter was passed from the anus through the anastomosis and allowed to remain for three days, and a small amount of sulfanilamide powder was dusted about the pelvis before closure. Blood transfusions were given the day prior to operation, during the procedure and in the postoperative period. Penicillin and sodium sulfadiazine were given in the immediate postoperative period, and the use of streptomycin was begun on the third postoperative day because of a sharp febrile reaction which persisted until the sixth day and disappeared slowly

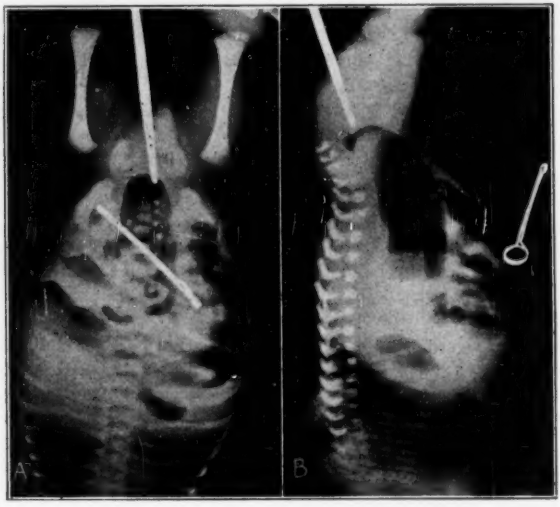


Fig. 3.—Roentgenograms with infant inverted and hemostat in anus depressing obstructing septum. *A*, anteroposterior view; *B*, lateral view.

thereafter. The abdomen was distended, but the colostomy opening functioned. Moderate scrotal edema appeared, and pelvic cellulitis was suspected. Four weeks after operation a no. 14 F. catheter could be passed through the anastomosis and the colostomy opening, and it was left in place; progressively larger catheters were passed at intervals so that the anastomosis contained a no. 26 F. catheter at the time of discharge on the forty-fourth postoperative day, when the patient weighed 16¼ pounds (7.4 Kg.).

One week later the catheter was removed, and the index finger could be passed through the stricture with difficulty. The mother was instructed to perform digital dilation daily.

At the age of 25½ months, after preliminary preparation with phthalylsulfathiazole, the redundant colostomy opening was excised, and end to end anastomosis of the sigmoid colon was performed. Penicillin and sodium sulfadiazine were

again administered. The patient passed feces on the fourth day after operation, and was discharged on the twenty-sixth postoperative day with a stricture which easily admitted the index finger.

On subsequent office visits the stricture was found to be dilated rapidly by the normal passage of feces. One year after the final operation the stricture could not be identified by the examining finger and the child was in excellent health, having normal bowel movements and controlled bowel habits.

## COMMENT

Because of the normal appearance of the anus in this type of malformation it is reported to be common for these infants to be admitted late for surgical care. Colostomy for relief of obstruction has been condemned by some but is recommended by most authors if the obstruction is long-standing, as in this case.[7] A primary repair of the defect in an obstructed premature infant would not be technically feasible and would certainly multiply the risk. The delay before definitive repair until the age of 14 ½ months permitted the infant to undergo the procedure in a satisfactory state of health.

The choice of the transabdominal repair is open to question[8]; most authors advise proctoplasty via the perineal approach if the rectal pouch is not too high, and an oblique anastomosis is said to offer less chance for stricture formation. The aim is the restitution of the fecal current between two normal segments of bowel and not between the undescended bowel and the skin as in the more common type 3 anomalies. A direct anastomosis is obviously desirable to preserve the integrity of the lower segment. The route of approach is debatable; the widespread opinion that the transabdominal approach should not be employed has generally been based on the results in patients treated during a period when intestinal anastomoses in general bore a higher mortality than at present. Whether this advice holds awaits the publication of recent case reports. With modern adjuncts such as continuous suction, chemotherapy and antibiotics, surgery of the adult pelvic colon has become less hazardous. Anastomosis from the perineal approach can be extremely difficult in an infant and may require invasion of the peritoneal cavity from below if the rectal pouch is high. Visualization is probably better with the abdominal approach except in the case of an extremely short anal pouch. The severity of the postoperative reaction in the patients treated by perineal proctoplasty is not obvious from the necessarily brief

7. David, V. C.: Surgery of the Rectum and Anus, in Lewis, D.: Practice of Surgery, Hagerstown, Md., W. F. Prior Company, Inc., 1947. Tuttle, J. P.: Diseases of the Anus, Rectum and Pelvic Colon, New York, D. Appleton and Company, 1902. Bacon and Hering.[2a]

8. Mastin, W. M.: A Résumé of the Surgical Treatment of Anorectal Imperforation in the Newborn, Surg., Gynec. & Obst. **7**:316-323, 1908.

histories recorded in the larger series of cases. In our case it was severe and might have proved fatal without chemotherapy and antibiotics. The ultimate result two and one-half years after colostomy and nearly one and one-half years after the anorectal anastomosis is considered perfect.

## CONCLUSIONS

The type 4 congenital anorectal malformation involves anastomosis of two segments of colon. This can be performed in many cases via the perineal approach. Modern therapeutic accessories permit a transabdominal approach with less hazard than was present at the time that such a procedure was generally discontinued, and this method should probably be reserved as a delayed stage operation for cases which require primary colostomy. Most of the modern therapeutic safeguards did not entirely obviate complications in the case under discussion.

## SUMMARY

The embryology and incidence of the type 4 (Ladd and Gross) congenital rectal anomaly are discussed, the adaptable surgical procedures are presented, and the case of a premature infant in whom an excellent result was obtained by delayed transabdominal repair is described.

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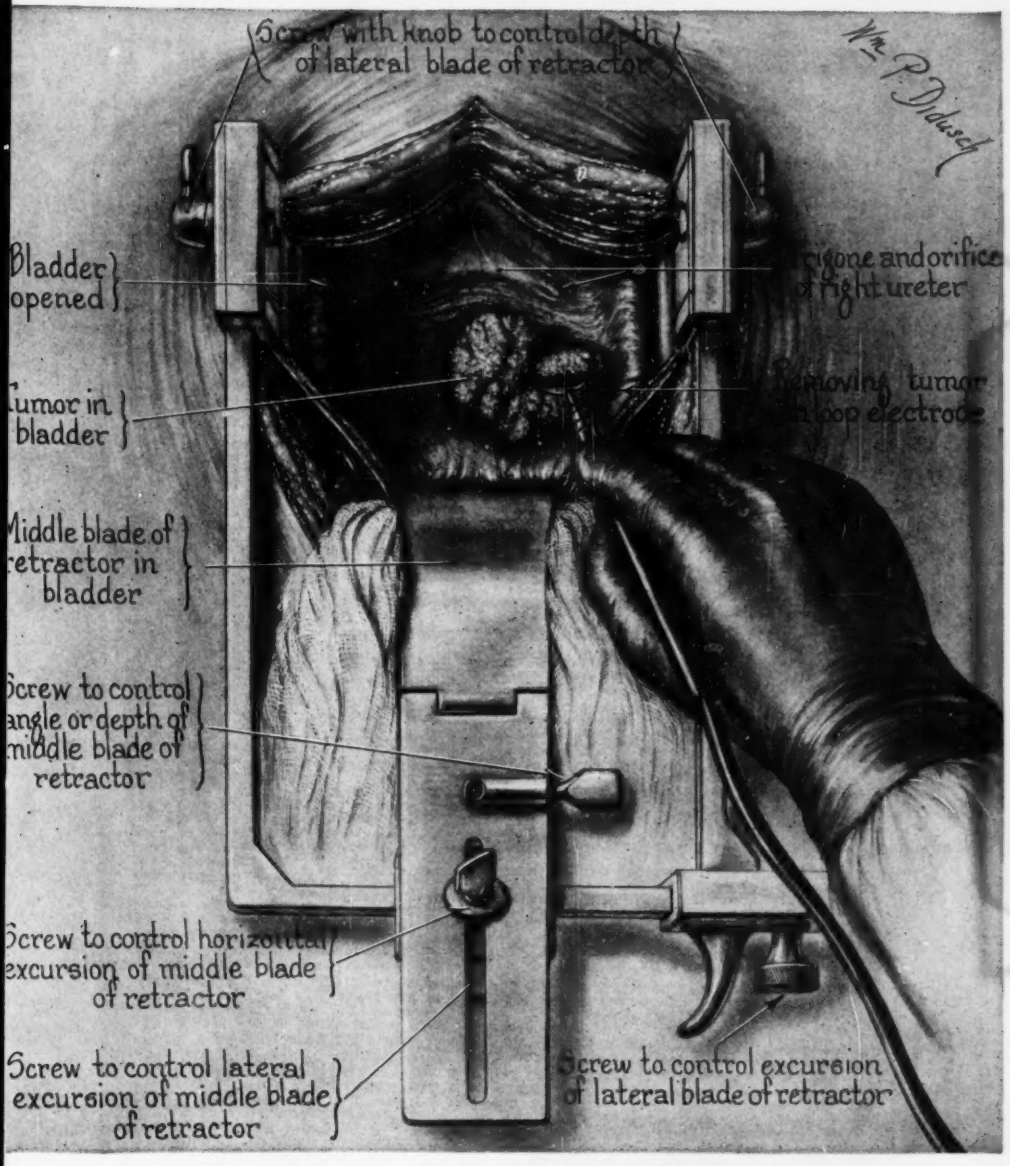
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Wm. P. Didusch
Bladder opened
Tumor in bladder
Middle blade of retractor in bladder
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